***E&MJ* at San Francisco Fair**—Opening this month on Treasure Island, in San Francisco Bay, the Golden Gate International Exposition offers unusual attraction to visitors from the Western mining States. The Hall of the Mineral Empire will be the focal point of interest, in which Treasure Mountain will house mining and milling operations on a scale large enough to be impressive and instructive to the general public. In fact, the aim of the entire mining exhibit is to make the public more intelligent about the mining industry, and all exhibits will be designed to this end. *E&MJ* will be represented throughout the exposition at a booth where visitors will be welcome. Our exhibit will be pictorial in character, featuring many of the World's large mining and metallurgical operations, and providing important statistical data on the mining industry. Current issues of the *Journal* will be available month by month, and a copy of each issue will also be placed in the statistical library and reference room that will be maintained by the California Commission in the mining exhibit. Visitors are invited and urged to take advantage of the facilities that *E&MJ* cordially extends.

▼

Large Radium Purchase—What is believed to be the largest purchase of radium has been made by the National Cancer Institute of the Public Health Service, Washington, D. C., for distribution to hospitals for cancer treatment. The shipment amounts to 5½ grams of radium salt contained in 1,245 hollow needles, each holding from 1 to 25 milligrams, and all incased in protective lead containers weighing about a thousand pounds. The radium will be measured at the Bureau of Standards by means of the gold-lead electroscope, a process that will require six months.

▼

Open-Pit Transport problems will be discussed further by L. C. Moore in the March issue. Part V will deal with miscellaneous electric haulage systems.

H. C. PARMELEE
Editorial Director

Engineering and Mining Journal

A. W. FISHER
Manager

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H. W. CLARKE
Vice-President

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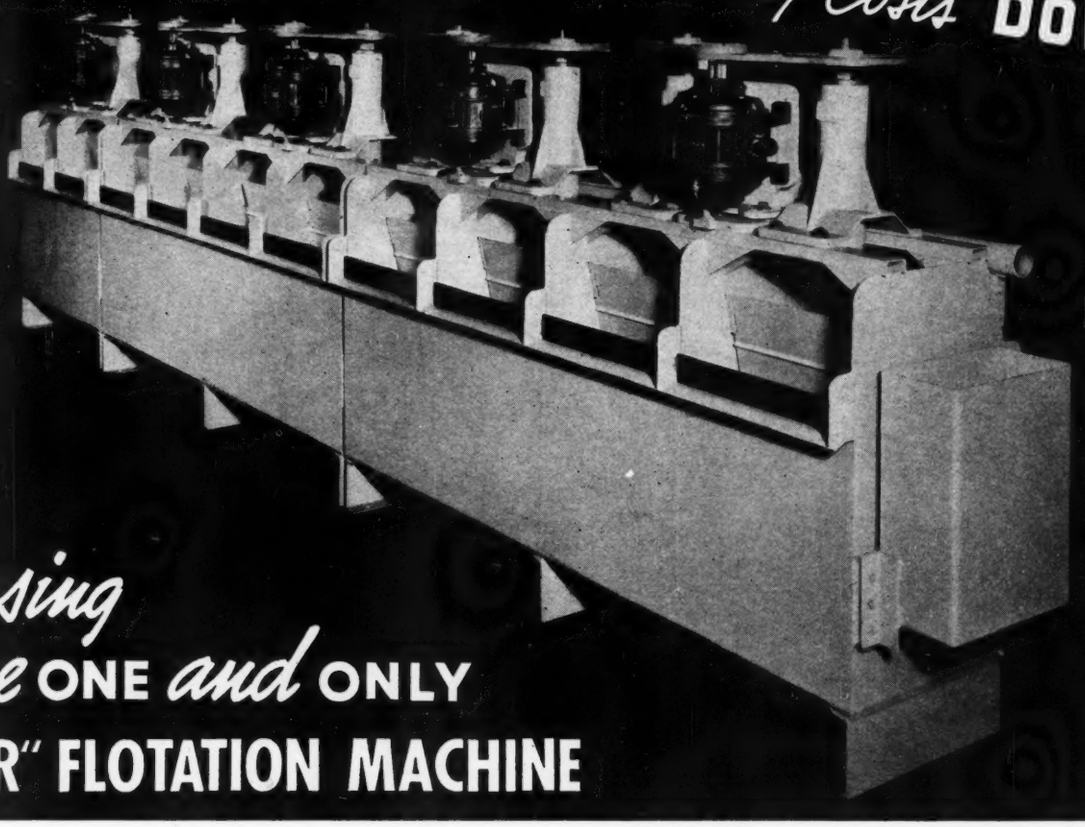

By using the ONE *and* ONLY "AGITAIR" FLOTATION MACHINE

Above photograph illustrates a 10-cell No. 24 "AGITAIR" recently shipped to a mining company in South Africa for treatment of oxidized copper ores.

The successful operation of the "AGITAIR" is due to and characterized by the cone-shaped impeller with depending square cross-sectional fingers (see illustration below). The air is introduced through a pipe extending through the cell bottom underneath the cone-shaped impeller. The "cone" acts as a chamber or reservoir for the air until it is disseminated into the pulp. This fine dissemination with intense agitation, is one of the reasons the AGITAIR FLOTATION MACHINE has proven so efficient mechanically and metallurgically.

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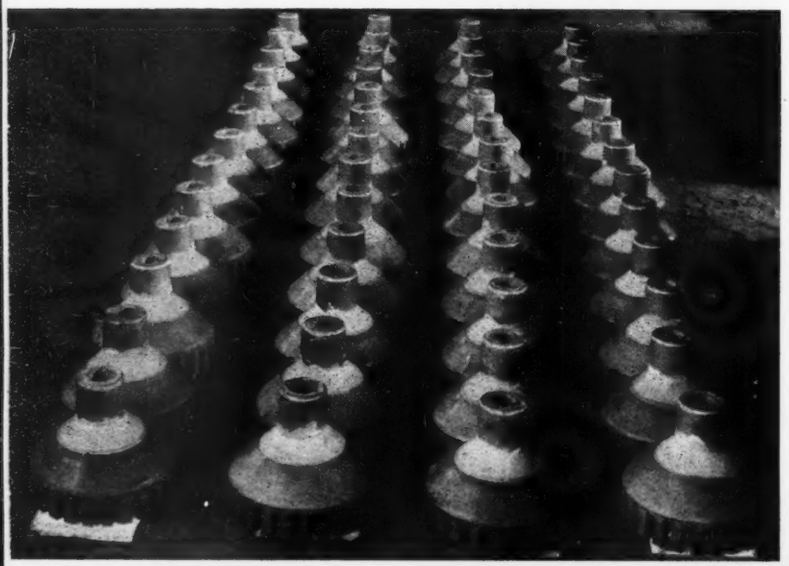

Important recent improvements in the AGITAIR that have helped to lower maintenance costs and assist in operation, are:

1—*Reversible Stabilizer*—doubles the life.

2—*V-shaped baffles*—gives quiet frothing zone and quickly removes froth.

3—*Rubber-covered impellers*—Easy to apply, gives three times longer wear.

4—*More Flexible Construction*—Permits insertion or removal of 4 or 2-cell units.

5—*Manganese steel liner plates in agitation zone*—Rubber-covered bottom liner remains standard.

Milling production need never be stopped by the AGITAIR, because repairs can be easily made and machine will start with full load after temporary shutdowns.

Photograph on left shows white cast iron impellers with new molded rubber gloves vulcanized in place. Number shown is but a portion of total required on one foreign shipment of AGITAIR machines recently made. This is but ONE of AGITAIR'S many means of holding down maintenance costs.

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Review and Outlook

1938 *1939*

Engineering and Mining Journal

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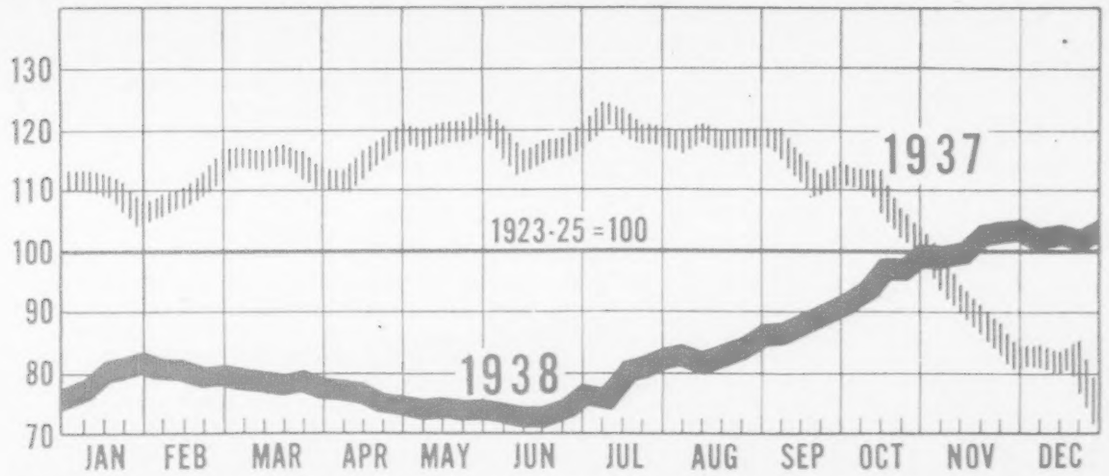
Volume 140 Number 2

FEBRUARY 1939

REVERSING THE ECONOMIC TREND of 1937, *Business Week's* index of business activity for 1938, shown herewith, records distinct improvement during the last six months of the year, crossing the 1937 line in early November and closing on a hopeful note for 1939. On the whole, the line for 1938 fairly represents the trend of conditions in non-ferrous metal mining. The detailed record, however, again throws into sharp relief the relative fortunes of the monetary and industrial metals. Gold producers continued their record-breaking production under the stimulus of price. Copper, lead, and zinc operators, on the other hand, had to curtail output in an effort to adjust production to reduced industrial demand.



GOLD again flowed from the mines at an all-time high rate for quantity and value in both the United States and the World. Domestic production in 1938, including the Philippines, exceeded that for 1937 by 270,000 ounces, while world output rose about 1,900,000 ounces. The Rand led all other areas with an average production of more than one million ounces a month. Domestic silver production fell off about nine million ounces, due largely to curtailed output of base metals. Otherwise, world production of silver remained about the same as in 1937. The price of newly mined domestic silver was static at 64.64c. per ounce throughout 1938, and will remain at that figure until June 30, 1939, when the future status of the metal will again be determined by political action.

REDUCED INDUSTRIAL DEMAND for the major metals—copper, lead, zinc—was responsible for curtailed domestic output in 1938. Home consumption of each of these metals was about 30 per cent less than in 1937. The foreign position was complicated by the shadow of war and shifting production quotas, but 1938 production of these metals outside the United States varied little from that of 1937. Price fluctuations and other data are recorded in the following pages.

THE DOMESTIC ZINC INDUSTRY suffered a grievous blow from the State Department by tariff reduction in the new trade agreement with Canada. The Department's reply to criticism of the reduction shows confusion worse confounded, and confirms the suspicion that the change in the tariff was an unfortunate blunder.

THE OUTLOOK for mining in 1939 is for improved conditions, at least during the first half of the year. Favorable to the consumption of base metals are prospects for increased activity in housing, automobile manufacture, electrical manufacture, utility expansion. The current emphasis on armament is also a favorable factor, but one easily overestimated. General industrial recovery will be the most vital influence in the welfare of metal mining, and the industry is prepared to meet any demands made upon it.

Gold

Output of the metal continues increasing. End of boom not yet in sight. The problem confronting the monetary authorities

By a Correspondent

Washington, D. C.

PRELIMINARY ESTIMATES, presented in Table I, indicate that gold production in 1938 amounted to over 37,000,000 oz., against 35,100,000 in 1937 and barely 19,318,000 in 1929. The story thus continues to be one of steady expansion to successively higher levels of output that would have been regarded as fantastic dreams a few years ago. And the end has apparently not been reached yet. With the exception of Russia, which is reported to have encountered technical and administrative difficulties and for which estimates are in any case open to question, there was no indication of a slowing up in the growth of gold production in 1938. Assuming the Russian estimates to be approximately correct, the physical output of gold in 1939 will be fully twice as large as in the last half of the 'twenties. In immediately succeeding years this high level of production will almost certainly be maintained.

Growth of gold production during the present decade has been due largely to the higher prices paid for gold by monetary authorities throughout the world as a direct outcome of the world depression. As the value of foreign trade shrank and nervous money began to shuttle back and forth between markets, one country after another found that its receipts from sale of goods and services, and from financial transactions, were insufficient to cover its outgo. Gold payments were suspended and the gold value of currencies declined. The percentages by which various currency prices of gold have increased since 1929 are shown in Table II. At these higher prices it has been profitable for mines to mill ore with a gold content below the previous limit of payability and to increase substantially the scale of operations. In most countries the response has been rapid. Production in the United States and Canada, for example, is much more than double that of 1929, and in many other countries the increase has been threefold and more. South African production, on the other hand, has increased only 17 per cent, due in part to the fact that many mines choose to mill ore of an average grade equivalent to the average of the entire workable ore reserves of the mine instead of taking out higher grade deposits first; also to the Government's ingenious tax schedule, and to the great depth of the Rand deposits and the expensive equipment required.

A writer[1] expresses the opinion that, unless the profitability of mining is further increased, the rapid rise in the output of countries other than South Africa may be expected to be checked within the next few years and perhaps to decline because of the higher rate at which their ore reserves are being exhausted, but that in South Africa the prospect is for a large and persistent expansion. He inclines to the view that world production will continue to expand for a considerable period.

Some consideration must be given, however, to the possibility that the conditions which have made gold mining exceptionally profitable in recent years will not persist and that the expansion of gold output will be checked or a contraction initiated as the result either of a rise in mining costs or a reduction in prices paid for gold. Any considerable increase in business activity and prices throughout the world is almost certain to be accompanied by a rise in costs of mine labor, services, and materials. It is true that gold mining wages and the cost of services may rise less steeply than those in other types of industry, and it may be taken as certain that the prices of mining materials will not rise as much as the established indexes of wholesale prices. None the less, some increase in the costs of gold mining is to be expected during a period of general business recovery.

Prospects for a reduction in the prices paid for gold by monetary authorities are more difficult to appraise. At $35 an ounce the value of gold output in 1938 was nearly $1,300,000,000, or more than three times as large as in the late 'twenties. Although a gold output double in volume and triple in value that of a decade ago is no longer a fantastic dream, it has become something of a nightmare to monetary authorities, particularly in the United States. This country has

Table I—World Gold Production

In Fine Ounces

	1938*p*	1937	1929
Principal gold-producing countries			
North America	10,719,826	9,747,153	4,791,493
United States (inc. Philippines)	5,056,308	4,804,540	2,208,386
Canada	4,714,000	4,096,213	1,928,308
Mexico	949,518	845,400	654,799
South America	799,274	714,901	169,618
Colombia	509,912	442,222	136,576
Chile	289,362	272,679	33,042
Russia	5,255,000	5,255,400	707,300
Africa	14,136,515	13,569,640	11,354,729
South Africa	12,156,818	11,734,575	10,412,326
Rhodesia	816,427	808,448	561,512
West Africa	707,368	594,929	208,053
Belgian Congo	455,902	431,688	172,838
Asia and Oceania	1,888,917	1,712,771	785,345
Australia	1,568,231	1,381,135	421,476
British India	320,686	331,636	363,869
Totals, principal countries	32,799,532	30,999,875	17,808,485
Other countries	4,309,859	3,983,699	1,509,476
World totals	37,109,391	34,983,574	19,317,961

p Preliminary.
Table based on figures published in Annual Reports of Director of the Mint and in Federal Reserve Bulletin.

[1] F. W. Palsh, "Causes of Changes in Gold Supply," *Economica*, Nov., 1938.

Table II—Percentage Increases In Prices of Gold

1929 to December 1938 Principal gold-producing countries	Approximate % Increase in Price
United States	70
Canada	70
Mexico	310
Colombia	190
South Africa	80
Australia	125
British India	75
England (British colonies)	75
Belgium (Belgian Congo)	40
Japan, Korea, and Formosa	185
Other countries	
France	155
Netherlands	25
Switzerland	40
Denmark	120
Norway	95
Sweden	90
Argentina	130
Brazil	245

Computed on basis of exchange rates.

acquired more than $7,000,000,000 of gold since January, 1934, and there can be little doubt that the high level of gold output was an important factor in the magnitude of the gold flow to the United States and in the problems of monetary management that it has created. It is not surprising, therefore, that when the United States —driven into action by the boom that began in the latter part of 1936—tried various devices to curb the influence of the gold flow on the credit situation, the world should jump to the conclusion that a reduction in price, which would strike at the root of the problem, was a possibility.

Though the gold scare struck financial markets suddenly in April 1937 it was an outgrowth of an economic situation that had been developing and of circumstantial evidence that had been accumulating for some time. Six months before, following the greater promise of monetary stability afforded by the downward readjustment of the currencies of France, Netherlands, and Switzerland and by the Tripartite Declaration, hoarders began to doubt the wisdom of hanging onto their gold holdings in a period of expanding business. Many decided to seek more profitable employment for their funds, and a substantial amount of gold came out of hiding. Much of this gold went to the countries that had just devalued, but some came to the United States, where foreigners were interested in acquiring American securities.

Meanwhile, inauguration of the Treasury's gold sterilization policy, a second increase in the reserve requirements of banks belonging to the Federal Reserve System, and initiation of discussions concerning methods of re-

(*Continued on page* 42)

—Silver

U. S. Treasury continues to buy metal in large quantities. The year was relatively quiet

Dickson H. Leavens

Cowles Commission for Economic Research

THE PAST YEAR has been another of comparative inactivity for silver. The price range was 2c., as in 1937; the price was unchanged at 44¾c. through March 25, and then dropped 1c. on March 28 and 1c. more on March 29 to 42¾c., at which level it remained for the rest of the year. The price in London varied between 18⅝d. and 20⅛d. in sympathy with fluctuations in the dollar-sterling exchange rate. For newly mined American silver, the price of 64.64c., set by President Roosevelt's proclamation of Dec. 31, 1937, was in effect throughout the year.

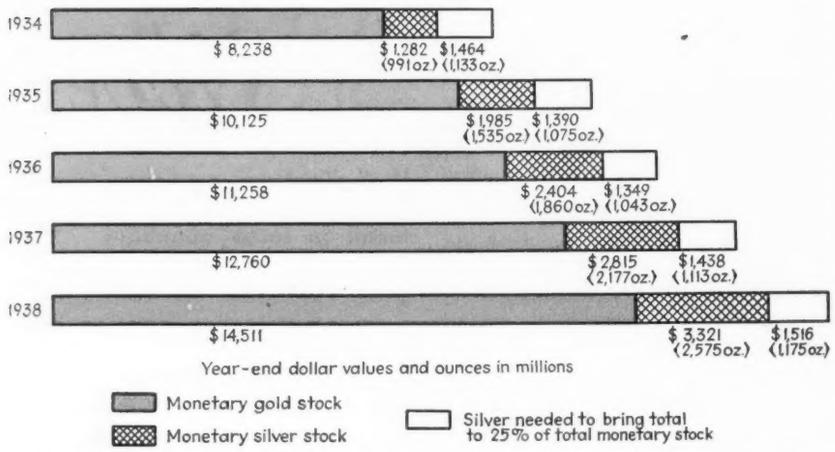
Production of silver at 264,800,000 fine ounces failed to reach the peak of 1937. American production in partic-

Table III—Sources and Uses of Gold and Change in Unreported Holdings January 1931 to December 1938

In Millions of Dollars at $35 an Ounce

	Total *p*	July 1937 to Dec. 1938*p*	Oct. 1936 to June 1937	January, 1931, to September, 1936					
				Total	1936 (9 mos.)	1935	1934	1933	1932	1931
Sources of gold:										
Mine output (excluding U.S.S.R.)	7,119	1,650	756	4,713	715	883	823	794	776	722
Receipts from:										
Indian private holdings	1,301	73	52	1,176	88	163	206	234	355	129
U.S.S.R.	690	167	150	373	11	25	86	68	82	100
China, Straits Settlements, and Egypt	389	22	12	355	18	29	52	68	114	73
Return of coin	325	75	.....	250	1	35	51	98	65	.....
Return of scrap	930	131	66	733	66	110	144	146	162	105
Totals	10,754	2,118	1,036	7,599	899	1,245	1,362	1,409	1,554	1,129
Reported uses of gold:										
Increase in reported central gold reserves (excluding U.S.S.R.)	7,383	1,640	2,098	3,645	136	532	1,532	−19	964	500
Industrial consumption	691	126	63	502	63	78	66	76	87	132
Total	8,074	1,766	2,161	4,147	199	610	1,598	57	1,051	633
Indicated increase in unreported official holdings and private hoards in western countries	2,680	352	−1,125	3,452	701	635	−236	1,352	504	496

p Preliminary.
Table published in Federal Reserve Bulletin for August 1937, brought up to date mainly on basis of figures published regularly in Bulletin.



After heavy buying of silver for the past four and a half years under the Silver Purchase Act, the Treasury at the end of 1938 still found itself about a billion ounces short of maintaining one-fourth the value of its monetary stock in silver

ular was off 7,900,000 oz. from 1937, a surprisingly small decrease in view of the reduced price and the effect of the recession on the demand for metals with which silver is found as a by-product.

In China war conditions necessitated the institution of exchange control by the National Government in March, and this caused the exchange value of her paper dollar to drop by nearly 50 per cent from the 30c. level at which it had been successfully maintained since China went off the silver standard in November, 1935. This depreciation may tend to delay the movement of silver out of such hoards as are left in the country. China exported silver to the extent of more than 60,000,000 oz. during the year. This brings the total export, since the outward movement began in 1933, to over 1,000,000,000 fine ounces, of which about one-quarter represents the estimated quantity smuggled out. The United States Treasury announced in June that it would have purchased over 250,000,000 fine ounces from China in the period from 1936 to July 15, 1938. It must have purchased indirectly most of the remaining silver which has come out of China in the last five years. The balance, which can hardly exceed 100,000,000 fine ounces, represents silver held by China in New York or London, ready to sell to the Treasury as fast as it is ready to take it. Since Secretary Morgenthau announced in July that the agreement with China had been extended indefinitely, it is not unlikely that this balance will be taken up at the rate of at least 50,000,000 fine ounces per year. The control of most of China's ports by Japan makes it improbable that any further large quantity of the white metal will come on the world market from China in the immediate future, but some may dribble out.

The Indian Government apparently sold little silver derived from melted rupees during 1938. It holds, however, about 574,000,000 rupees, or about 160,000,000 fine ounces, ready to sell; this stock is increasing at the rate of 50,000,000 rupees, or 17,000,000 fine ounces, a year, representing the surplus rupee coins which the Reserve Bank of India is entitled to sell back to the Government. Meanwhile, during 1938 rupee coins have flowed back from circulation to the Bank to the extent of about 140,000,000 rupees, containing nearly 45,000,000 fine ounces of silver. It would seem, therefore, that the Bank will be making use of its privilege to sell back 50,000,000 rupees a year to the Government for several years to come. This means the continued existence of a large stock of silver potentially on the market. For the past few years the Government of India has refrained from any large sales, perhaps because dissatisfied with the current price, but it may sell this asset sometime.

The demand of the Indian people for silver for the ornament trade, which revived so promisingly in 1935, when the price of silver dropped to what seemed a bargain level, fell off to only about 14,000,000 fine ounces for 1938. The estimate made in this review last year that the Indian people might continue to absorb between 50,000,000 and 75,000,000 fine ounces per year proved unduly optimistic. Nevertheless, it would seem that given any reasonable prosperity they should usually take more than they took in 1938.

The agreements of the United States Treasury to purchase silver from Mexico and Canada were announced at the end of 1937 to be on a month-to-month basis. Early in 1938 the quantities involved (which had never been made public before) were announced to be 5,000,000 and 2,000,000 fine ounces per month respectively. At the same time it was stated that the Treasury was taking off the hands of Mexico some 35,000,000 fine ounces, representing that country's accumulation of her own newly mined silver during the four years 1934 to 1937, inclusive, under the terms of the London Silver Agreement of 1933. In March, when the Mexican Government seized foreign oil properties, Secretary of the Treasury Morgenthau announced that the United States would buy no more silver from Mexico after April 1 until further notice. The price dropped in London and the Treasury allowed the New York price to drop 2c. to 42¾c. Although no longer buying directly from the Mexican Government, the United States Treasury has continued to buy all the silver necessary to keep the price pegged at the new level, and has asked no questions as to the origin of the metal. The only effect on Mexico, therefore, was to make her dispose of her silver through the New York market, and receive a price lower by 2c., and by whatever expenses she incurred under the new plan.

(*Continued on page* 46)

WORLD'S SILVER PRODUCTION . . . In Fine Ounces

Country	1935	1936	1937	1938
United States	38,322,000	62,842,000	69,315,000	60,500,000
Canada	16,618,558	18,334,487	22,683,032	23,000,000
Mexico	75,587,447	77,462,114	84,678,921	85,000,000
Peru	17,104,300	19,914,482	17,000,000	19,200,000
Other America	14,175,464	17,883,042	20,860,222	17,750,000
Europe	17,616,410	18,782,711	19,648,231	20,100,000
Australasia	12,434,343	13,191,629	14,148,779	14,825,000
Japan	8,230,657	9,765,237	10,000,000	10,175,000
India	6,860,000	6,670,000	6,860,000	6,600,000
Other Asia	2,375,435	2,759,369	2,887,968	2,525,000
Africa	5,209,676	4,724,690	5,240,790	5,000,000
Totals	214,534,290	252,329,761	273,322,943	264,675,000

Statistics based on refinery output. Figures for 1935, 1936, and 1937 by American Bureau of Metal Statistics; 1938 estimated by *E. & M. J.*

Copper—

Domestic production of primary metal off, compared with 1937. Consumption high abroad

W. R. Ingalls

Director, American Bureau of Metal Statistics

IN THE U.S.A. we entered 1938 in the midst of an economic depression, as to which we became increasingly fearful. It did indeed become worse but fortunately it did not run very long.

The domestic consumption of copper fell to a rate of about 40,000 tons per month in the first semester, and during the first five months of this period sales by refiners averaged only about 25,000 tons per month. In June a turn of the tide was anticipated and there were sales aggregating about 90,000 tons in that month; and in July they aggregated upward of 125,000 tons.

These large transactions reflected accurate forecasts. Domestic consumption began to rise in July, continued to do so, and attained a rate of about 69,000 tons in October. Thereafter it fell again to about 57,000 tons in December. The total for 1938 will probably be found to have been about 600,000 tons, which will be about 70 per cent of the consumption in 1937. The relative rates of copper, lead, and zinc consumption will probably eventually be found to have been approximately the same.

Major factors in the decline in domestic copper consumption were the manufacture of fewer automobiles, refrigerators, radio sets, etc. The manufacture of electrical machinery, including small motors, transformers, etc., did not decline so much. The uses for telephone construction and light and power (public utility) plant were substantially unchanged from 1937. Governmental transmission and distribution, including rural lines, required rather more of the metals (aluminum being a competitor of copper). Our physical volume of building and the quantity of copper entering into it, especially in the forms of copper and brass pipe, were about the same in 1938 as in 1937. Consequently it will be seen that our domestic channels of copper consumption did not run equally low.

Outside of the United States there was not the same economic depression from which we suffered and consumption continued at a very high rate. Producers viewed this with their fingers crossed, and out of caution the cartel decided to reduce production from 105 per cent to 95 per cent, effective July 1. Instead of requirements easing off, however, they appeared rather to be increasing. In October the cartel raised the rate of production to 105 per cent and a few days later released its members from any restriction. The market quickly reflected the opinion that this was a mistake; and the cartel promptly resumed restriction, reducing the rate to 100 per cent to become effective Jan. 1, 1939.

These kaleidoscopic and rather uninteresting changes were reflected in the markets; or perhaps it was vice versa. At the beginning of 1938 the

(*Continued on page* 46)

WORLD'S COPPER PRODUCTION . . . In Short Tons

Country	1935	1936	1937	1938
United States	380,100	614,971	839,344	562,000
Canada	208,224	210,824	262,432	290,000
Mexico	45,880	35,960	51,538	40,000
Chile	294,404	282,418	455,455	358,000
Peru	32,687	36,764	39,064	39,500
Germany	33,289	34,171	35,274	36,000
Russia	69,717	91,491	101,963	112,000
Spain and Portugal	34,858	31,127	34,546	35,500
Japan	78,169	81,350	83,665	85,000
Africa	295,638	272,183	416,231	362,000
Elsewhere	144,066	158,253	185,833	186,000
Totals	1,617,032	1,849,512	2,505,345	2,106,000

Statistics based on blister copper, so far as possible, and referred to countries wherein ore originated. Does not include secondary copper. Figures for 1935, 1936, and 1937 by American Bureau of Metal Statistics; 1937 *E. & M. J.* estimate.

—Lead

Domestic production and shipments lower. Price down but steady. Year closes strong

F. E. Wormser

Secretary Lead Industries Association

FLUCTUATIONS of the lead market in 1938 were comparatively small. The opening price of 4.75¢. per pound New York was close to the year-end price of 4.85¢. The average for the year of 4.739¢. proved to be 21 per cent below the average for 1937 of 6.009¢., and, although still far under the level of prices from 1922 to 1930, it was the best yearly average, with the exception of 1937, since 1930.

Average Yearly Price of Lead
Cents Per Lb. New York

1922	5.734	1931	4.243
1923	7.267	1932	3.180
1924	8.097	1933	3.869
1925	9.020	1934	3.860
1926	8.417	1935	4.065
1927	6.755	1936	4.710
1928	6.305	1937	6.009
1929	6.833	1938	4.739
1930	5.517		

The outlet for lead during the first half of 1938 was disappointingly small, shipments of 182,000 tons from January to June, inclusive, being substantially below domestic production of 218,000 tons, so that once again stocks began to accumulate while the price gradually softened to a low of 4.00¢. In June, sales gave a sudden spurt, almost trebling in that month, and keeping well above production month after month. The price of lead advanced to 4.90¢. by July 6 to a high of 5.10¢. by Sept. 19. Owing, however, to the discouraging effect of declining lead prices up to June, production was curtailed in the Rockies and remained so. Therefore, mounting sales soon reversed the upward trend in the accumulation of refined lead, and stocks were actually smaller at the close of 1938 than at the beginning by probably 15,000 tons. This estimate, and other estimates which follow, are made before the complete statistical picture is available and are subject to revision.

Had it not been for a poor London market for non-ferrous metals, during the last quarter of 1938, the domestic price of lead might have kept on an even keel, but London became weak in December during a quiet spell in

the domestic market, so that the price in New York dropped to 4.75¢. However, this weakness was of only short duration, and as soon as the London market reacted upward, the price domestically followed to 4.85¢. At the time of writing London is still the key to the immediate future of the lead market.

Domestic production of newly mined lead in the United States for 1938, together with a small amount of secondary and foreign metal, totaled about 410,000 tons, compared with 533,000 tons for 1937, representing a decline of 23 per cent. It is significant that the domestic price of silver of 64.64¢. per ounce did not, apparently, act as a stimulus to production from the silver-lead mines as in previous years.

WORLD'S LEAD PRODUCTION . . . In Short Tons

Country	1935	1936	1937	1938
United States	371,212	400,009	469,892	382,000
Canada	165,357	184,659	205,479	204,750
Mexico	204,172	240,670	254,810	236,000
France	6,393	7,951	40,970	48,000
Germany	134,811	153,220	179,344	191,500
Italy	39,870	45,933	43,087	47,100
Poland	14,093	16,558	19,386	14,500
Other Europe	254,336	229,054	234,980	242,000
Australia	243,046	221,121	254,408	246,250
Burma	80,707	81,936	87,024	89,500
Elsewhere	51,855	65,246	96,954	118,600
Totals	1,565,852	1,646,357	1,886,334	1,820,200

Production in terms of bullion, allocated according to country of origin of ore. Figures for 1935, 1936, and 1937 by American Bureau of Metal Statistics; 1938 estimated by *E. & M. J.*

Domestic shipments of refined lead are estimated at 425,000 tons in 1938, compared with 576,000 tons in 1937, a decline of 26 per cent. Shipments for the year were in excess of current production and account for the decrease in total stocks of pig lead that occurred from June on, as noted in the foregoing. All the larger outlets for lead used smaller amounts of lead in 1938 than in 1937, storage battery consumption showing the sharpest drop.

Stocks of pig lead at the beginning of 1938 were 129,000 tons; at the end they are estimated to be 115,000 tons, or about three months' supply at current rate of consumption. During the last six months stocks were absorbed at the rate of 10,000 tons per month.

Of growing significance during the last few months has been the weakness in sterling exchange. Low sterling exchange has a depressing effect on world commodity prices, and should the trend continue without compensating influence, the American market would be injured. Depreciated foreign exchange acts as an offset to the protection afforded by a tariff. It would appear that currency instability is again introducing an unpredictable element in the future of the metal markets.

Accumulation of scrap lead by smelters during the first half of 1938 was only about half that for the corresponding period in 1937, owing, doubtless, to the declining price of lead, which always discourages the sale of scrap material. Conversely, a sharp recovery occurred in the last half, but, even so, 1938 closed with a lower amount of old battery plates recovered and smelted by about 30 per cent compared with 1937.

The manufacture of white lead dry and in oil continues to be an extremely important outlet for the lead miner. Domestic production for 1938 is estimated to be about 105,000 tons, slightly larger than the total for 1937 of 100,000 tons. White lead-in-oil is used directly as paint, whereas dry white lead is used primarily by manufacturers as a base for the best prepared paint, but also in enameling and other applications. In conformity with a decreased use of new pig lead for storage-battery manufacture, the demand for litharge also declined. It is estimated that some 64,000 tons of litharge was produced in 1938, compared with 80,000 tons in 1937. Similarly, red lead manufacture also showed a decline, the total being an estimate of 28,000 tons for 1938, compared with 34,000 tons for 1937. The production of numerous other pigments, such as the sulphates, chromates, and orange mineral, swelled the total tonnage of pig lead consumed in the manufacture of these chemical compounds.

It is not generally appreciated that a comparatively large tonnage of pig lead is consumed by the manufacture of lead pigments—about 265,000 tons in 1938, and about 240,000 tons in 1937. Besides a wide use in paint and storage-battery manufacture, these pigments find application in insecticide manufacture, oil refining, the ceramic industry, rubber and linoleum manufacture, and numerous other uses.

Although the United States is the world's greatest source of lead it is not the world's greatest user. That honor must go to Great Britain, where lead consumption averaged over 35,000 tons per month in 1938, compared with only 33,000 tons for the United States. The per capita consumption, the true measure, shows an even larger disparity.

Refined lead production of the world in 1938 is estimated to be 1,800,000 tons, of which, as usual, the United States was the largest contributor. Mexico and Australia each produced some 240,000 tons of lead, followed by Canada with 200,000 tons. Increasingly important supplies of lead come from Yugoslavia, Peru, and the Argentine. The United States is essentially a balanced producer of the metal, generally furnishing more than enough for domestic requirements and not competing in the foreign market. Nevertheless, the world situation has an important bearing upon domestic prices. It controls the limit to which the domestic price can rise.

World lead production was more than Europe could absorb in the latter half of 1938. Consequently the price abroad was so shaky that a meeting of lead producers outside the United States was held in London during the summer to seek a remedy for the situation. It was subsequently reported that producers outside the United States agreed to curtail production 10 per cent, beginning Nov. 1, 1938, with a view to lifting the low price of the metal.

Mexico continues to be the most important source of imports of lead into the United States, followed by Peru and Australia.

The year-end closed with pig lead in a strong statistical position, consumption at a higher rate than production, production low, and stocks in a comfortable position.

With 1939 promising to be a better year for the automobile industry, the prospects are good for an improved demand for storage batteries, but, as has been frequently stated, the lead used in storage batteries is for the most part really a loan. It sooner or later returns to the smelter as scrap. Far more important for the lead miner is the outlook for painting. Returning prosperity should produce a better painted countryside, from which white lead should benefit. Moreover, if the utility industry were to engage in much needed expansion of its facilities, the outlook for lead would be pleasant indeed.

Zinc

Unexpected cut in duty a blow. Year saw reversal from shortage to ample stocks

Marshall L. Havey

General Sales Manager, New Jersey Zinc Company

A GLANCE at recent available zinc statistics gives no intimation of the uncertain condition facing the zinc industry. One finds that the stock of metal rose rapidly in less than one year from an acute shortage (less than a week's supply) in August, 1937, to the highest figure in many years this last June 30—149,671 tons. This marked turn-about in the statistical situation was due to the small shipments of metal in the first half of 1938—both because of the low operating rate of those industries which consume zinc, and because many of those industries had built up considerable inventories of metal during the last three months of 1937. These inventories they subsequently cut to a minimum before reordering.

Dec. 1 of 1938 found a considerably better statistical position. The 120,000 ton stock, though large by comparison with that of December, 1937, had been exceeded several times in the past—in six of these last ten years the figure has been of the same order of magnitude. Deducting unfilled orders, this stock represents somewhat under two months' supply at the present rate of use.

Though the stocks of metal have touched the low and high record limits within eighteen months, last year's fluctuations in price were narrow. During 1938 Prime Western metal scarcely stepped outside the boundaries of 5¢. and 4¢. Following marked weakness early in the year, the market strengthened as consumption increased, and the Prime Western market had risen to 5.05¢. by mid-November. This was still low in comparison with long-term average, and moderate when compared to prices of other metals or to the commodity index. But with the consumption increasing there was assurance that this poor year in the zinc industry was to be followed by a fairly good one in 1939, and that a steady rate of employment was in prospect—until the Canadian Trade Agreement was published on Nov. 18.

Upon release of the terms of this Agreement, uncertainty displaced hope. On Nov. 21 a drop from 5.05¢. to 4.75¢. reflected the reduction in duty. A further reduction in price to 4.50¢. followed a drop in the London market and in sterling exchange. The year ended, therefore, with domestic producers in doubt as to the future.

Turning from the recent statistical history of zinc in the United States to look at the future, one finds that unpredictable world conditions—rather than the comparatively orderly industrial fluctuations in the United States—must be taken into consideration in projecting the possibilities for the zinc industry in this country, with a tariff protection against these foreign uncertainties which is now less by $7 a ton than it has been for the last sixteen years.

In addition to the complexities of

(*Continued on page* 49)

WORLD'S ZINC PRODUCTION . . . In Short Tons

Country	1935	1936	1937	1938
United States	431,499	523,166	589,619	456,470
Canada	149,103	151,697	158,643	170,000
Mexico	44,084	35,506	40,364	40,000
Belgium	200,332	215,301	248,656	235,000
France	56,729	59,084	66,611	66,700
Germany	136,906	150,354	179,895	211,000
Great Britain	67,717	68,086	69,597	65,000
Poland	93,688	102,062	118,219	121,000
Australia	74,856	77,778	78,120	74,000
Russia	50,922	71,650	71,650	72,000
Elsewhere	181,252	185,043	203,261	204,830
Totals	1,487,088	1,639,727	1,824,635	1,716,000

Production by primary metallurgical works. Figures for 1935, 1936, and 1937 by American Bureau of Metal Statistics; 1938, *E. & M. J.* estimate.

Tin

Reduced demand and overproduction continue. The five-year agreement is revised

E. Baliol Scott

Editor, "The Mining Journal" London, England

IN MANY WAYS 1938 proved a complete contrast to 1937, as regards the tin industry. The conclusion reached in last year's review that large invisible stocks had accumulated, especially in the United States, has been fully justified by the absence of consumptive buying on any large scale over practically the whole year, despite great reduction in output. To some extent the overproduction and decline in buying demand were but a continuation of the slump which began at the end of March, 1937, but the consequences were fully felt only in the year under review. The average price of standard cash for 1938 was £189 12s. 1d., compared with £242 6s. 6d. in 1937, the lowest average figure since 1932. The extremes were: highest, £217 (Dec. 30) and lowest, £153 5s. 0d. (May 3). The price of Straits tin in New York was highest at 46.70c. on Dec. 29 and lowest at 35c. on May 3. Towards the end of the year, owing to the contracting supplies of Straits and increasing Japanese purchases, the premium on Straits increased to £7 and more over the London parity.

The fact that this experience befell the industry in the second year of the new tin agreement confirms previous experience that though tin restriction is a powerful influence on price, it is secondary to variations in American demand.

Realization that virtual abeyance of restriction during 1937 had been allowed to continue too long, resulted in plans being worked out to give the International Tin Committee more drastic control over production than had been attempted, and in effect in the second quarter of the year several of the most important provisions of the 1937 five-year agreement were abrogated. The change was introduced in the guise of forming a fresh buffer pool advocated as the only way in which to secure greater stability of price. These proposals for a new tin pool were first published in *The*

Mining Journal (London) of March 26, 1938, p. 341. Their most important feature was that every country electing to take part in the pool had to surrender the right to give notice of withdrawal from the control if "outside" production during six months exceeded 15 per cent of the world production, or 12,500 tons of metal, whichever was less. Ultimately, all member countries accepted the buffer pool scheme, thus insuring its continuance, if desired, at any rate until the end of 1941. The general idea is to maintain prices between a minimum of £200 and a maximum of £230 per ton and that, after the initial contributions from the producing countries, it should be self-regulating, as the Controller would sell at or near the top price and thus acquire finance for purchasing when the price falls to a level attractively below this figure—the general idea being based on the exchange stabilization fund technique. However, until profits are made on the sale of pool stocks, the Controller does not appear to be in a position to thus operate either way.

The extent of the reduction in demand and the magnitude of the invisible stocks were tardily recognized by the International Tin Committee. During the first quarter the quotas were fixed at 70 per cent of the basic tonnages, and for the second at 55, but for the second half international quotas were cut to 35 per cent international quota with a further additional quota of 10 per cent contribution to the buffer stock.

When we turn to study statistics, the figures so early in the year must be largely a matter of estimate. As to production, presuming that quotas are observed, we should have the following figures for the countries within the restriction agreement amounting to perhaps 80 per cent of the world's output: Malaya, 42,973 tons; N.E.I., 21,702 tons; Bolivia, 21,929 tons; Siam, 12,540 tons; Congo, 6,403 tons; Nigeria, 6,321 tons; and Indo-China, 1,967 tons; total restricted, 113,835 tons.

Production from "outside" countries was estimated by the Hague Statistical Office in 1937 as 27,487 tons. This appears conservative, and therefore despite the fact that the Chinese output appears to have fallen towards the end of the year, I am assuming that last year's output may have been unchanged at, say, 27,000 tons. This, therefore, gives us a total output last year of say 141,000 tons, of which say 8,000 tons was in the buffer pool. In this connection it must be borne in mind that the quota for the first six months of the year averaged 62½ per cent and in the second half of the year 45 per cent, of which 10 per cent was for the buffer pool. As the 35 per cent free quota has been fixed up to the end of March, it is clear that the position at the end of the year did not fully reflect the reduction in the world output, and the supply currently available.

In respect to consumption, as remarked at the outset, it was the falling off in the United States' deliveries during 1938 (a 33,000-ton drop) which was the most outstanding feature of the year, but large reductions were experienced in other directions. The Hague Statistical Office consumption estimates as present available only cover the first ten months of the year; averaging the last two months we get a figure for the whole year of 155,280 tons compared with 198,700 tons in 1937, and as compared with the output for the year, an apparent deficien-

(*Continued on page* 49)

WORLD'S TIN PRODUCTION . . . In Long Tons

Country	1935	1936	1937	1938
Bolivia	27,168	24,074	25,024	25,300
Great Britain	2,050	2,099	2,000	1,925
China	9,500	10,500	10,200	10,500
Burma	4,102	4,547	5,000	5,100
Malaya	45,955	66,806	77,542	43,250
Siam	9,779	12,678	16,385	13,500
Netherlands E. I.	24,719	31,684	39,779	21,100
Nigeria	7,029	9,634	10,444	7,300
Belgian Congo	6,118	7,302	9,138	7,450
Australia	3,130	3,028	3,300	3,450
Elsewhere	7,422	8,057	9,655	9,600
Totals	146,972	180,409	208,467	148,475

Tin production figures are on ore basis. Source: American Bureau of Metal Statistics for 1935, 1936, and 1937; *E. & M. J.* estimate for 1938.

Gold

(*Continued from page* 37)

straining the inflow of foreign capital, which was the main factor in the movement of gold to the United States, made it apparent that authorities in this country found the continued purchase of gold a most unwelcome necessity. Then, in March, 1937, it began to look as if Great Britain, too, had no desire to acquire further large quantities. In that month substantial amounts of Russian gold were offered for sale in London. When the British stabilization fund failed to acquire this gold, and it moved on to the United States, it was thought that Great Britain might withdraw from the gold market, leaving the United States as the sole important buyer. A fantastic report, credited for a while, that Russia had $7,000,000,000 of gold reserves available for sale in world markets, added to the general nervousness.

This was the situation when, early in April, 1937, President Roosevelt declared that in his opinion certain commodity prices were too high. Such a statement, coming from the head of an Administration that had raised the price of gold to bring about recovery in prices, was thought to imply that a contrary policy might be followed to combat inflation and reduce the volume of gold purchases. The gold scare began almost immediately.

Table IV — Production of Gold In the United States

In Fine Ounces

Western States and Alaska:	1937	(a) 1938
Alaska	627,940	667,000
Arizona	332,694	310,000
California	1,174,578	1,294,400
Colorado	368,905	370,100
Idaho	81,861	101,000
Montana	202,252	197,200
Nevada	281,332	289,700
New Mexico	41,171	38,600
Oregon	52,662	77,100
S. Dakota	581,544	594,000
Texas	562	455
Utah	322,759	210,650
Washington	36,310	73,400
Wyoming	1,776	877
Eastern States:		
Alabama	2,460	30
Georgia	743	833
Maryland	1,040	847
N. Carolina	949	1,870
Penn	1,348	1,402
S. Carolina	2,482	11,125
Tennessee	263	300
Virginia	1,396	2,814
Central States:		
Michigan	51	.....
Philippines	716,967	862,397
Puerto Rico	17	9
Totals	4,834,062	5,106,109
Value (b).	$169,192,182	$178,713,815

(a) Preliminary figures compiled by the Denver office of the Bureau of Mines, United States Department of the Interior.
(b) Value on the basis of $35 per fine ounce.

The interpretations of both the British and American intentions were undoubtedly mistaken. Nevertheless, those hoarders who had not yet decided that the time was ripe to get rid of their holdings became frightened, and during the three months of the scare they dumped one-half to three-quarters of a billion dollars of gold on the London market.

The dishoarding movement came to an end in June, 1937, partly because the most volatile holdings had been liquidated and partly because the price boom had collapsed in the interval and security markets had turned downwards. The summer of 1937 was comparatively uneventful, but when, in September, business activity and prices in the United States began to decline rapidly, the attitude towards gold was reversed. Early in that month the United States Treasury desterilized $300,000,000 of gold. Subsequently, as business conditions became worse, rumors began to circulate abroad that the United States gold price might once again be raised as a recovery measure. Foreign short-term money was withdrawn from this country in large volume and gold hoarding in London resumed. In February, 1938, the Treasury's gold sterilization policy was modified, and in April it was abandoned in conjunction with a small reduction in the reserve requirements of banks in the Federal Reserve System. Hoarding increased during most of 1938 as a result of new currency uncertainties. By the year end there appears to have been nearly as much gold in private hoards as before dishoarding began in September, 1936.

Table III presents data indicating the trend of hoarding since it assumed importance in 1931. Because of the existence of large unreported official holdings, the difference between the visible supplies and the visible uses of gold does not accurately represent the amount of private hoarding.

It is evident that public opinion concerning gold is strongly influenced by the course of business and prices. In the first place, as the opportunities for safe and profitable investment in commerce and industry grow, the advantages of holding gold diminish. Second, conditions of expanding business are precisely those in which official action to keep the money-creating power of gold within bounds is most likely. Such action would not necessarily involve a reduction in the price of gold, however. It might, for example, take the form of sterilization, which was tried in the United States between December, 1936, and April, 1938, and which has been practiced in England since 1932 as an automatic feature of the operations of the stabilization fund. Or it might consist of some direct restriction on gold production.

(*Continued on page* 46)

—Minor Metals

Recession at home and events abroad exert varying influences on these markets. Improvement realized in second half

Economics Division

Bureau of Mines, Washington, D. C.

MARKETS for minor metals in 1938 were affected to a large degree by the industrial recession in the United States, but world events continued to play an important rôle. Heavy demand in Europe for industrial raw materials for armaments continued throughout the year, although international movements were restricted temporarily by the war scare prior to the Munich agreement. However, the dominating influence proved to be the sharp recession in the United States which began the latter part of 1937 and continued in the first half of 1938, resulting in accumulation of stocks and a generally weakened price structure. In the latter half of the year business here improved, but markets displayed diverse trends.

Despite the downward trend in consumption in 1938, world production of many minor metals was higher; in some cases new records were established.

Antimony—The downward trend in prices evident at the close of 1937 continued in 1938. Quotations for domestic metal fell from 13.75c. per pound in January to 10.75c. in August. Under improved seasonal demand prices were advanced to 12.25c. early in December, but again declined to 11.25c. by the middle of the month. At the close of the year the quotation stood at 11.75c. Quotations for Chinese metal ranged from 17.00c. in January to 14.00c. in December.

In China, supplies moved freely for export over the Hankow-Canton railway to Hongkong until the Japanese campaign on Canton in October. At present, with the mines under Chinese domination and rail and river routes cut by Japanese, there is probably little movement of antimony from the mines.

The improved strategic position of the United States in antimony since the establishment of a smelting industry in Texas is being threatened by recent developments in Mexico, whence we derive our principal ore supply. The uncertain attitude of the Government in that country and finally the imposition of an Export tax has retarded development of antimony mines there. Total imports of antimony in ore into the United States declined from 13,818 short tons in 1937 to 6,686 tons in the first ten months of 1938.

Ore supply to the Laredo smelter apparently was adequate thoughout 1938, although the plant was shut down from April 25 to Sept. 24. Finished products on hand were ample to meet the trade's reduced requirements at all times. Antimony oxide was in better demand than metal during 1938.

American Smelting & Refining Company is reported to have begun production of metallic antimony at its Perth Amboy plant, rated at 50 to 75 tons daily capacity. Annual production of 1,400 tons of antimony from flue dusts is expected from a new plant at Trail, B. C.

Arsenic—Domestic production and consumption of arsenic decreased substantially in 1938. Imports were off about 25 per cent. Consumption of insecticides was stimulated by the fight waged by Federal and State Governments against outbreaks of grasshoppers and Mormon crickets in the western Great Plains States and against the white-fringed beetle in the Southern States. However, consumption of boll-weevil poisons was restricted by low cotton prices and of weed killers by the serious plight of railroads. White arsenic quotations remained at the low price of 3c. per pound.

Bismuth—A slight decline in domestic production of bismuth and no material change in consumption are indicated for 1938. Producers of pharmaceutical and alloys continued to be the principal consumers; the use of bismuth and arsenical compounds in fighting venereal diseases is increasing. Early in May, 1938, the price for bismuth metal advanced from $1 to $1.05 per pound in New York and from 4s. to 4s. 3d. in London; quotations for the compounds advanced later. Bismuth imports totaled

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72,020 lb. in the first ten months of 1938, compared with 67,225 lb. for all of 1937. Metal exports, chiefly to the United Kingdom, totaled only about 100 short tons from January to October, 1938, compared with about 450 tons in all of 1937.

Cadmium—The decline in automobile production in 1938 was reflected in lower prices for cadmium and a sharp decrease in imports. Producers' minimum price on Jan. 1 on quantity business for commercial sticks was $1 per pound and the quotation for platers' patented shapes was $1.35. As a result of price cuts in April, August, September, and November, the quotations at the year end were 60 and 85c. respectively. A 5c. per pound reduction on Nov. 22 was attributed by the trade to the cut in import duty on cadmium from 15 to 7½c. per pound, effective Jan. 1, 1939, resulting from the Canadian Trade Agreement, signed Nov. 17. *E. & M. J.* monthly averages beginning in 1939 will include an average price based upon producers' quotations on ordinary commercial shapes, quantity business, as well as the old average of ordinary and platers' patented shapes. Imports into the United States dropped from 828,535 lb. in 1937 to only 20,342 lb. in the first ten months of 1938. Despite lower prices and declining demand, domestic production of metal is estimated to have decreased only slightly in 1938. According to reliable sources, the use of cadmium in bearings fell off about 50 per cent, but an increase in consumption is anticipated for 1939 as a result of greater automobile production and the growing need for replacements. There were new users of cadmium bearings during 1938 and apparently few, if any, former users discontinued their use. No new cadmium plants were built in the United States in 1938, but recovery of byproduct cadmium from zinc plants at Josephtown, Pa., Henryetta, Okla., and Fort Smith, Ark., was begun late in 1937.

Chromium—The market for chromite in 1938, in contrast to 1937, was featured by lower prices, and ample supplies were available all year. Quotations in domestic journals on metallurgical grade ore containing 48 per cent or more of Cr_2O_3 dropped from $26 a long ton at the beginning of the year to $23 in the last quarter. Domestic imports for the first ten months were 331,500 long tons, 28 per cent below 1937. With the domestic steel industry at low operating rates during most of 1938, it is believed that domestic consumption declined even more, so that some of the ore imported was stocked. Delivery was suspended on some contracts to American consumers. A feature of the import trade in 1938 was the larger receipts from the Philippine Islands: 77,733 tons for the first ten months of 1938 compared with 43,648 tons for all of 1937. Most of the metallurgical ore from the Philippines came from the Florannie and the Acoje mines, but the known ore at the former was virtually depleted during the year. Imports from all other sources declined. Despite the lower demand, world production in 1938 may surpass the record established in 1937. Turkish production may reach 250,000 tons for the year; production at the Guleman deposit near Ergani was increased and the ore, which is of metallurgical grade, entered the American market.

Exploration and development continued in California and Oregon, but domestic production was still insignificant compared with domestic demand.

Chromite was bound on the free list in the trade agreement with the United Kingdom signed Nov. 17, 1938.

Cobalt—Consumption of cobalt in the United States declined considerably in 1938; imports for the first ten months decreased about 17 per cent, small increases in receipts of ore and metal having been more than offset by a decline of 64 per cent in oxide. Consumption abroad apparently decreased also. Domestic quotations for metal and oxide were unchanged.

Incomplete statistics indicate substantial increases in output in Northern Rhodesia and French Morocco and declines in British India and Canada. No data are available on Belgian Congo and Finland, although imports from Finland into the United States increased from 74 short tons in the first ten months of 1937 to 239 tons in the same period of 1938. In the Belgian Congo new rich deposits have been discovered, and the cobalt-refining capacity in Belgium has been expanded. Germany is developing domestic deposits and a new prospect at Kilembe, Uganda, is being explored. Three small mines near Puerto del Huasco, Chile, were reported reopened in 1938. In the United States development work was in progress at a deposit near Keating, Ore., and a new find was reported near Porthill, Idaho.

Magnesium—Domestic and world magnesium output in 1938 is estimated at more than 2,700 and 21,000 short tons, respectively. New plants are being constructed in the United Kingdom, Italy, and Japan.

Research is progressing on the removal of iron and copper impurities in magnesium alloys and on coatings for magnesium to protect it from corrosion. The Bureau of Mines, with the cooperation of the State College of Washington, is continuing its investigation on the flotation of low-grade magnesite ores and on the production of magnesium therefrom. The nominal price for magnesium remained at 30c. per pound throughout 1938. Unofficial published data indicate that magnesium exports, chiefly to Japan and the United Kingdom, totaled more than 700 short tons during the first ten months of 1938, compared with 40 tons in 1937.

Manganese—Domestic quotations for 50 per cent manganese ores dropped from 45c. a long ton unit c.i.f. north Atlantic ports, duty not paid, at the beginning of 1938, to 30c. at the close, as a result of (1) lowering of ocean freight rates and (2) easing of demand in world markets. Exports from the U.S.S.R. amounted to 266,000 long tons for the first nine months of 1938, a drop of 65 per cent from the like period in 1937, and waterborne shipments from India for the first nine months were 30 per cent lower. Drastically curtailed steel operations in this country during most of the year served to reduce greatly domestic consumption and imports were at a much lower rate. For the first ten months they amounted to 373,844 long tons—only 44 per cent of the 1937 record figure for the same period. Although domestic production will probably be less in 1938 than in 1937, output was buoyed up by the higher prices that maintained during the first quarter and by the Navy contract for 11,500 tons of ferromanganese which specified the use of domestic ores.

Manganese ore, together with other strategic mineral commodities, continued to attract attention, and several bills providing for emergency stockpiles were introduced into Congress. Hearings were held by the subcommittee of the Senate Military Affairs Committee, but no further legislative action was taken.

There were no changes in the duty on manganese ore during 1938, but in the trade agreement with Canada signed on Nov. 17 the prevailing rates on ferromanganese and spiegeleisen were reaffirmed.

Mercury—Normal international trade in mercury was hampered again in 1938 by civil war conditions in Spain, which severely restricted production. As in 1937, however, ample supplies of metal were available and consumption in Germany and the United Kingdom appeared to have surpassed the high rates attained in 1937. It even appeared likely that a larger share of world demand was met by Spanish metal in 1938. In the United States, consumption was lower as imports fell sharply and domestic production failed to make up the difference.

Italy maintained its record rate of production with an output of 50,764 flasks in the first nine months of 1938, but exports dropped to 37,014 flasks. Mexico produced 4,548 flasks and exported 4,468 flasks in the first six months of 1938.

In the United States a small increase in production appeared likely in 1938, but considerably less metal

was available for consumption, as imports in the first ten months were only 12 per cent of those for 1937. In addition to mercury imported as such, an unknown but reported substantial amount of foreign metal was made available through imports of ore from Mexico for treatment in this country. Domestic prices ranged from $70 to $84 per flask during 1938, and the year closed with quotations at $77 to $78.

Although less mercury was apparently consumed in the United States in 1938, prospects for its increased use were evident.

Molybdenum—World production of molybdenum continued its upward course in 1938 due largely to increased domestic output, which established a new peak of about 33,000,000 lb. as a result of increased output from the Climax mine, the principal producer. Despite some curtailment at midyear, the first half of 1938 and 1937 was tion, the new equipment at Climax, installed in 1937, permitted a large increase in production during closing months of the year, and output for the year may have reached 28,000,000 lb. of molybdenum. Other producers of molybdenum recorded decreases with the exception of the Mammoth-St. Anthony operation.

Exports from Norway for the first ten months were 619 metric tons, 23 per cent above 1937, and production in Mexico for the first eight months was 607 tons, 17 per cent below the previous year.

Purely nominal domestic trade-journal quotations on molybdenite concentrates containing 90 per cent MoS_2 increased in March from 42 to 45c. per pound of contained MoS_2. London quotations, however, declined.

Platinum Metals — Production of platinum metals at Sudbury during the first in the history of this opera- 130,077 and 125,886 oz., respectively, but with the curtailment of operations during the last six months of 1938, the yearly total probably will be slightly less than in 1937. Production in South Africa during the first nine months of 1938 and 1937 was 49,300 and 33,100 oz., respectively. There was little change in Colombia's output, but production in the United States (Alaska) increased greatly. Thus, world production of platinum metals (exclusive of U.S.S.R., for which authentic information is lacking) in 1938 more than likely will exceed the record output of 379,000 oz. in 1937.

Refined platinum was quoted at $36 an ounce until May, when it declined to $33. After a rise to $37 in October it declined again to $34 at the close of the year. Palladium was quoted at $24 an ounce throughout 1938, and the price of iridium ranged from $85 to $65 an ounce.

YEARLY AVERAGE PRICES MISCELLANEOUS METALS . . .

Year	Aluminum	Antimony	Cadmium	Quicksilver	Platinum
1938.....	20.000	12.349	98.037	$75.469	$35.901
1937.....	19.917	15.355	122.335	90.180	51.773
1936.....	20.000	12.240	97.789	79.917	42.926
1935.....	20.000	13.616	70.491	71.992	34.150
1934.....	23.300	8.901	55.000	73.865	36.465
1933.....	23.300	6,528	55.000	59.227	30.993
1932.....	23.300	5.592	55.000	57.925	36.455
1931.....	23.300	6.720	56.010	87.351	35.665
1930.....	23.787	7.667	(a)	115.009	45.358
1929.....	24.300	8.956	(a)	122.145	67.655

Quotations for aluminum, antimony, and cadmium in cents per pound; quicksilver in dollars per flask of 76 pounds; platinum, refined, in dollars per troy ounce.
(a) Not averaged by *E.&M.J.*

Imports of platinum metals into the United States during the first ten months of 1938 dropped sharply to 145,599 oz., compared with 194,940 oz. in the corresponding period in 1937, and exports of unmanufactured platinum and allied metals declined to 29,791 oz., compared with 49,679 oz. in 1937.

Tungsten—Interest in the tungsten market centered upon conditions in China. Though the Japanese made large gains during the year, their success has not taken them into the producing areas. However, with the capture of Shanghai the regular commercial route for the transportation of tungsten was in Japanese control, and there were no shipments from this port in 1938. Material was routed by rail through South China to Canton. This route likewise fell to the Japanese late in 1938, but ore continued to move out, principally through Swatow. Despite the continued threat of interrupted supplies from China, the price of tungsten dropped sharply during the first half of 1938. The London quotations more than halved and reached 36s. per long ton unit in May, but this was followed by increases during the latter months, the price reaching 60s. in November. Apparently the trade felt that large stocks had been accumulated by consumers during 1937, and with the situation in Europe easier, purchases were made only for current needs, which in some countries were not at a maximum rate. Large stocks are also being held in Hongkong. During the first half of 1938, shipments from China continued at a good rate as a result of a barter agreement with Germany, whereby war supplies were accepted in exchange for tungsten concentrates. Similar shipments went to the U.S.S.R. Exports from China amounted to 11,061 metric tons for the first nine months of 1938, compared with 14,496 tons in the corresponding period of 1937.

Domestic consumption apparently fell off sharply in 1938. Imports for consumption amounted to only 844 short tons for the first ten months, compared with 4,252 tons for the same period in 1937. Domestic price quotations likewise were lower, but the drop was not as pronounced as in London. While operations at some producing properties were reduced during the year, the development and re-equipment of tungsten properties continued in the Western States, and several new mills were constructed. Developments in the area around Bishop, Calif., attracted attention during 1938 and a 300-ton mill was completed by the U. S. Vanadium Corporation on the Pine Creek operation where extensive reserves are reported to have been developed.

Vanadium — Supplies of vanadium for domestic consumption increased in 1938. Though imports for consumption were lower in 1938 than in 1937 (ten-month figures), domestic production increased sharply. Operations in Paradox Valley, now the principal producing area, continued to expand and output in 1938 will approximately double that of 1937. The U. S. Vanadium Corporation, which has a 250-ton mill, is the principal producer in this area, but in 1938 ore containing about 500,000 pounds of V_2O_5 came from other operations in this and other areas. Despite the import trade, several carloads of ore from our Western States was exported to Japan.

World sources of vanadium may be supplemented further in the future by the recovery at ferrous smelters of vanadium from the treatment of pig iron made from vanadium-bearing iron ores in Germany.

A plant for the recovery of vanadium was completed in 1938 in Japan by the Japan Iron Sand Industrial Company.

Purely nominal quotations for ore were unchanged throughout 1938 at 27½c. per pound of contained V_2O_5.

Gold

(*Continued from page* 43)

All these devices, however, entail difficulties, many of which were discussed in the Annual Report of the Bank for International Settlements for 1936. Sterilization is unsatisfactory because it involves an increase in the public debt and in the interest burden. Evolvement of a smoothly operative restriction scheme would not only present administrative problems but would run into a conflict of interests between the leading gold-producing countries on the one hand and the leading gold-buying countries on the other. Similarly, a reduction in the price of gold would undoubtedly meet with objections from countries in which the gold-mining industry contributes importantly to the national welfare. Unless, moreover, the prices of gold were reduced, by international agreement, in the same proportion by all countries, exchange rates would be altered in a manner that would adversely affect the competitive position in world markets of the countries that lowered their gold prices.

Reduction in the price of gold would, however, have the advantage of reducing immediately and proportionately the value of gold output and of tending to curtail the physical volume of production. There is reason for doubt however, whether the latter of these effects would be immediately important. For one thing, mining capacity throughout the world has increased substantially in recent years. For another, a lower price for gold would force mines to shift operations to the higher-grade ores. Taken by itself this would tend to increase the amount of gold produced. A decline in total output would occur only if there was a sufficiently large reduction in volume of ore milled to offset the increase in the amount of gold extracted per ton. A decline in output would undoubtedly occur in some areas, but in others the level of production would be maintained and possibly increased. Over the long run, of course, the total production of gold would be diminished through the loss of payable ore reserves resulting from the reduction in the price of gold.

In this connection it may be pointed out that the foregoing considerations would apply *pari passu* in the event of a rise in the working costs of gold mining above present levels, and would tend to diminish the restrictive effect of such a rise on the volume of output.

On the whole, the chances of any serious curb to the production of gold in the next few years seem rather slim.

Silver

(*Continued from page* 38)

In addition to 35,000,000 fine ounces of silver from Mexico, some 40,000,000 fine ounces derived from old coin were sold by Spain and 22,000,000 fine ounces by Siam, according to Handy & Harman. This totals nearly 100,000,000 fine ounces, or more than has ever before been dumped on the market in a single year, exclusive of Chinese supplies.

The Treasury has continued to buy in large quantities. Beginning in July the "Daily Statement of the Treasury" has shown the ounceage of each class of silver (dollars, subsidiary coin, bullion in the certificate reserve, bullion in the general fund at cost, and bullion in the general fund at recoinage value). This makes it possible to see how fast the quota is being met, whereas hitherto, lacking ounce figures, it required rather troublesome computations to estimate from the dollar figures just what weight of silver was held. When the Silver Purchase Act was passed in June, 1934, it would have been necessary to secure 1,320,000,000 fine ounces, provided the stock of gold remained unchanged. As of Dec. 31, 1938, the stock of gold had increased greatly, and in spite of the purchase of nearly 1,900,000,000 ounces of silver since June, 1934, it still was necessary to acquire about 1,150,000,000 ounces more to make up a total equal to one-third of the gold stock.

Storage vaults for silver on the United States Military Reservation at West Point, N. Y., were completed during the spring, and the transfer of large quantities of the white metal from rented vaults in New York City was begun in July.

After the close of business on Dec. 31, the President by proclamation continued the price of newly mined domestic silver at 64.64¢ until June 30, 1939. This aroused little comment. Whether a special price for domestic silver can be continued beyond that date will depend upon what action Congress may take as to extending the President's monetary powers which then expire.

The only promising sign in the whole silver situation is the activity of the research scientists, who, under the sponsorship of the American Silver Producers' Association, are trying to find new uses for the white metal. It is a hopeful sign that the industry has recognized that much of the former world monetary demand has been destroyed, and that, when the artificial monetary demand of the United States Treasury, created by political pressure and subject to cancellation by the same means, is removed, its product must be assured of new outlets.

Copper

(*Continued from page* 39)

quotation for copper was 10⅛¢., New York. At the beginning of July it was 9¢. About the latter time an advance began in the foreign market, and the price in London rose and New York had to follow, our market rising to 11¼¢. delivered in Connecticut. At the time when the cartel authorized unlimited production the quotations were 11.25¢. delivered in Connecticut and 11.50¢., c.i.f. Hamburg, Liverpool, and Havre. The European price immediately began to decline, and at the end of December was 10.55¢., c.i.f. principal ports. The American price was maintained at 11¼¢., but domestic sales at that price were relatively small.

We have been all along confused in respect of analysis of the foreign requirements for copper, wondering to what extent they were industrial, to what extent military, and to what extent intermediate. No one can give any decisive answer to such questions. The construction of factories, railways, etc., may be immediately industrial, but may have military use in the background. However, we know that very large quantities of copper in 1938 went to Japan, which was engaged in active warfare; and large quantities also went to Russia and Germany, possibly for accumulations. Russia's own production of copper has not expanded so much as was hoped.

The subject of consumption is the chief concern in the copper industry, and little need be said in respect of production or stocks. Stocks of refined in U.S.A. at beginning of 1938, as reported by Copper Institute, were about 259,000 tons; and at end of December about 289,700. Refined stocks ex-U.S.A. at beginning of 1938 were about 212,000 tons; at end of December about 167,500.

The production of new copper ex-U.S.A. in 1938, excluding derivation from scrap, will be about 1,590,000 tons compared with 1,628,000 tons in 1937.

Production of new copper by primary producers in the United States in 1938 was about 525,000 tons, besides which there was about 117,000 tons produced from scrap, the corresponding figures for 1937 being 812,000 and 170,000 respectively. At the beginning of 1938 mine production was about 50,000 tons per month, which was gradually brought down to about 25,000 tons in July, after which it was stepped up to about 60,000 tons in November.

Domestic sales by the primary producers in the first half of 1938 were about 200,000 tons; in the second half about 314,000 tons, and at better prices than in the first half.

E & M J METAL PRICES FOR 1938 • BY DAYS

Including Monthly Highs and Lows and Monthly Averages

JANUARY

Jan.	Copper, Electrolytic Domestic	Copper, Electrolytic Export	Tin, Straits, New York	Lead, Common, New York	Silver, New York	Zinc, Prime Western E. St. Louis
1	Holiday	Holiday	Holiday	Holiday	Holiday	Holiday
3	9.900	9.475	41.125	4.75	44.750	5.00
4	9.900	9.525	41.625	4.75	44.750	5.00
5	10.025	9.700	42.000	4.75	44.750	5.00
6	10.025	9.850	41.750	4.75	44.750	5.00
7	10.275	9.975	42.000	4.85	44.750	5.00
8	10.275	10.050	42.000	4.85	.....	5.00
10	10.400	10.150	42.125	4.85	44.750	5.00
11	10.650	10.250	42.875	4.90	44.750	5.00
12	10.650	10.450	43.000	4.90	44.750	5.00
13	10.650	10.300	42.200	4.90	44.750	5.00
14	10.650	10.150	41.750	4.90	44.750	5.00
15	10.650	10.150	42.625	4.90	.....	5.00
17	10.525@10.650	10.300	42.500	4.90	44.750	5.00
18	10.525	10.400	41.625	4.90	44.750	5.00
19	10.275	10.175	41.500	4.90	44.750	5.00
20	10.025	10.050	41.625	4.90	44.750	5.00
21	10.025	9.850	41.375	4.90	44.750	5.00
22	10.025	9.825	41.125	4.90	.....	5.00
24	10.025	9.625	40.875	4.90	44.750	5.00
25	10.025	9.600	40.875	4.90	44.750	5.00
26	10.025	9.600	40.625	4.90	44.750	5.00
27	10.025	9.600	40.500	4.90	44.750	5.00
28	9.775	9.550	40.250	4.90	44.750	5.00
29	9.775	9.600	40.000	4.90	.....	5.00
31	9.775	9.500	40.750	4.90	44.750	5.00
High	**10.650**	**10.450**	**43.000**	**4.900**	**44.750**	**5.000**
Low	**9.775**	**9.475**	**40.000**	**4.750**	**44.750**	**5.000**
Average	**10.198**	**9.908**	**41.548**	**4.870**	**44.750**	**5.000**

FEBRUARY

Feb.	Copper Domestic	Copper Export	Tin	Lead	Silver	Zinc
1	9.775	9.525	40.875	4.90	44.750	5.00
2	9.775	9.600	41.000	4.90	44.750	5.00
3	9.775	9.500	40.600	4.90	44.750	5.00
4	9.775	9.400	40.600	4.90	44.750	5.00
5	9.775	9.400	40.750	4.90	.....	5.00
7	9.775	9.425	40.625	4.90	44.750	4.75@5.00
8	9.775	9.275	40.625	4.75	44.750	4.75
9	9.775	9.300	40.875	4.75	44.750	4.75
10	9.775	9.300	40.750	4.50	44.750	4.75
11	9.775	9.250	40.625	4.50	44.750	4.75
12	Holiday	9.275	Holiday	Holiday	Holiday	Holiday
14	9.775	9.225	40.625	4.50	44.750	4.75
15	9.775	9.250	41.125	4.50	44.750	4.75
16	9.775	9.375	41.500	4.50	44.750	4.75
17	9.775	9.525	41.750	4.50	44.750	4.75
18	9.775	9.675	42.000	4.50	44.750	4.75
19	9.775	9.775	42.500	4.50	.....	4.75
21	9.775	9.700	41.875	4.50	44.750	4.75
22	Holiday	9.850	Holiday	Holiday	Holiday	Holiday
23	9.775	9.975	42.750	4.50	44.750	4.75
24	9.775	9.950	42.250	4.50	44.750	4.75
25	9.775	9.675	42.250	4.50	44.750	4.75
26	9.775	9.700	42.250	4.50	.....	4.75
28	9.775	9.675	42.000	4.50	44.750	4.75
High	**9.775**	**9.975**	**42.750**	**4.900**	**44.750**	**5.000**
Low	**9.775**	**9.225**	**40.600**	**4.500**	**44.750**	**4.750**
Average	**9.775**	**9.525**	**41.373**	**4.632**	**44.750**	**4.813**

MARCH

Mar.	Copper Domestic	Copper Export	Tin	Lead	Silver	Zinc
1	9.775	9.600	41.875	4.50	44.750	4.75
2	9.775	9.625	42.000	4.50	44.750	4.75
3	9.775	9.625	41.750	4.50	44.750	4.75
4	9.775	9.650	41.875	4.50	44.750	4.75
5	9.775	9.650	41.750	4.50	.....	4.75
7	9.775	9.650	41.750	4.50	44.750	4.75
8	9.775	9.575	41.750	4.50	44.750	4.75
9	9.775	9.575	42.000	4.50	44.750	4.50
10	9.775	9.550	41.750	4.50	44.750	4.50
11	9.775	9.500	41.000	4.50	44.750	4.50
12	9.775	9.475	41.000	4.50	.....	4.50
14	9.775	9.500	41.125	4.50	44.750	4.25
15	9.775	9.600	41.750	4.50	44.750	4.25
16	9.775	9.650	41.400	4.50	44.750	4.25
17	9.775	9.575	41.500	4.50	44.750	4.25
18	9.775	9.525	41.250	4.50	44.750	4.25
19	9.775	9.525	41.500	4.50	.....	4.25
21	9.775	9.525	41.500	4.50	44.750	4.25
22	9.775	9.500	41.375	4.50	44.750	4.25
23	9.775	9.350	41.000	4.50	44.750	4.25
24	9.775	9.375	41.250	4.50	44.750	4.25
25	9.775	9.425	41.250	4.50	44.750	4.25
26	9.775	9.450	41.250	4.50	.....	4.25
28	9.775	9.325	40.750	4.50	43.750	4.25
29	9.775	9.325	40.500	4.50	42.750	4.25
30	9.775	9.175	39.000	4.50	42.750	4.25
31	9.775	9.100	38.000	4.50	42.750	4.25
High	**9.775**	**9.650**	**42.000**	**4.500**	**44.750**	**4.750**
Low	**9.775**	**9.100**	**38.000**	**4.500**	**42.750**	**4.250**
Average	**9.775**	**9.496**	**41.219**	**4.500**	**44.446**	**4.417**

APRIL

April	Copper, Electrolytic Domestic	Copper, Electrolytic Export	Tin, Straits, New York	Lead, Common, New York	Silver, New York	Zinc, Prime Western E. St. Louis
1	9.775	9.150	38.975	4.50	42.750	4.15@4.25
2	9.775	9.175	39.000	4.50	.....	4.15@4.25
4	9.775	9.200	38.750	4.50	42.750	4.15
5	9.775	9.250	38.250	4.50	42.750	4.15
6	9.775	9.250	37.850	4.50	42.750	4.15
7	9.775	9.275	38.000	4.50	42.750	4.15
8	9.775	9.275	38.750	4.50	42.750	4.00
9	9.775	9.275	39.000	4.50	.....	4.00
11	9.775	9.400	39.150	4.50	42.750	4.00
12	9.775	9.450	38.500	4.50	42.750	4.00
13	9.775	9.525	38.750	4.50	42.750	4.00
14	9.775	9.575	38.750	4.50	42.750	4.00
15	9.775	9.600	39.250	4.50	42.750	4.00
16	9.775	9.650	39.250	4.50	.....	4.00@4.25
18	9.775	9.650	40.000	4.50	42.750	4.15@4.25
19	9.775	9.725	39.000	4.50	42.750	4.25
20	9.775	9.600	38.625	4.50	42.750	4.25
21	9.775	9.500	38.375	4.50	42.750	4.25
22	9.775	9.525	38.625	4.50	42.750	4.25
23	9.775	9.500	38.750	4.50	.....	4.25
25	9.775	9.500	38.250	4.50	42.750	4.25
26	9.775	9.525	37.650	4.50	42.750	4.25
27	9.775	9.525	37.500	4.50	42.750	4.15
28	9.775	9.525	37.300	4.50	42.750	4.15
29	9.775	9.450	36.625	4.50	42.750	4.15
30	9.775	9.450	36.250	4.50	.....	4.15
High	**9.775**	**9.725**	**40.000**	**4.500**	**42.750**	**4.250**
Low	**9.775**	**9.150**	**36.250**	**4.500**	**42.750**	**4.000**
Average	**9.775**	**9.443**	**38.430**	**4.500**	**42.750**	**4.141**

MAY

May	Copper Domestic	Copper Export	Tin	Lead	Silver	Zinc
2	9.775	9.300	35.125	4.50	42.750	4.15
3	9.775	9.275	35.125	4.50	42.750	4.15
4	9.775	9.300	36.875	4.50	42.750	4.15
5	9.775	9.325	37.625	4.50	42.750	4.15
6	9.775	9.300	37.625	4.50	42.750	4.15
7	9.775	9.325	38.000	4.50	.....	4.15
9	9.775	9.275	37.850	4.50	42.750	4.15
10	9.775	9.325	38.000	4.50	42.750	4.00
11	9.775	9.300	37.800	4.50	42.750	4.00
12	9.775	9.275	38.250	4.50	42.750	4.00
13	9.775	9.275	38.100	4.50	42.750	4.00
14	9.775	9.250	38.000	4.50	.....	4.00
16	9.775	9.125	37.125	4.50	42.750	4.00
17	9.775	9.075	36.350	4.50	42.750	4.00
18	9.775	9.050	36.625	4.50	42.750	4.00
19	8.775	8.950	36.600	4.50	42.750	4.00
20	8.775	8.450	35.850	4.50	42.750	4.00
21	8.775	8.450	35.850	4.50	.....	4.00
23	8.775	8.250	36.500	4.25	42.750	4.00
24	8.775	8.200	37.200	4.25	42.750	4.00
25	8.775	8.025	36.750	4.25	42.750	4.00
26	8.775	7.850	36.150	4.25	42.750	4.00
27	8.775	7.850	35.800	4.00	42.750	4.00
28	8.775	7.925	36.200	4.00	.....	4.00
30	Holiday	8.000	Holiday	Holiday	Holiday	Holiday
31	8.775	8.100	36.750	4.00	42.750	4.00
High	**9.775**	**9.325**	**38.250**	**4.500**	**42.750**	**4.150**
Low	**8.775**	**7.850**	**35.125**	**4.000**	**42.750**	**4.000**
Average	**9.375**	**8.801**	**36.885**	**4.400**	**42.750**	**4.042**

JUNE

June	Copper Domestic	Copper Export	Tin	Lead	Silver	Zinc
1	8.775	7.975	37.375	4.00	42.750	4.000
2	8.775	8.125	38.375	4.00	42.750	4.000
3	8.775	8.200	38.750	4.00	42.750	4.000
4	8.775	8.200	38.500	4.00	.....	4.000
6	8.775	8.350	38.625	4.00	42.750	4.000
7	8.775	8.400	38.750	4.00	42.750	4.000
8	8.775	8.275	38.600	4.00	42.750	4.000
9	8.775	8.325	38.750	4.00	42.750	4.000
10	8.775	8.400	39.475	4.00	42.750	4.000
11	8.775	8.400	39.475	4.00	.....	4.000
13	8.775	8.325	39.125	4.00	42.750	4.000
14	8.775	8.275	38.700	4.00	42.750	4.000
15	8.775	8.300	39.125	4.00	42.750	4.000
16	8.775	8.300	39.750	4.00	42.750	4.000
17	8.775	8.325	40.875	4.00	42.750	4.000
18	8.775	8.350	41.150	4.00	.....	4.000
20	8.775	8.450	41.500	4.00	42.750	4.000
21	8.775	8.575	42.000	4.00	42.750	4.000
22	8.775	8.675	42.250	4.25	42.750	4.075
23	8.775	8.825	42.600	4.35	42.750	4.325
24	8.775	8.950	42.900	4.50	42.750	4.500
25	8.775	9.000	42.625	4.50	.....	4.500
27	8.775	9.050	42.600	4.50	42.750	4.500
28	8.775	9.025	42.250	4.50	42.750	4.500
29	8.775	8.875	42.650	4.50	42.750	4.500
30	8.775	9.050	43.000	4.75	42.750	4.500
High	**8.775**	**9.050**	**43.000**	**4.750**	**42.750**	**4.500**
Low	**8.775**	**7.975**	**37.375**	**4.000**	**42.750**	**4.000**
Average	**8.775**	**8.500**	**40.376**	**4.148**	**42.750**	**4.131**

E & M J METAL PRICES FOR 1938 • BY DAYS

Including Monthly Highs and Lows and Monthly Averages

JULY

July	Copper, Electrolytic Domestic	Copper, Electrolytic Export	Tin, Straits, New York	Lead, Common, New York	Silver, New York	Zinc, Prime Western E. St. Louis
1	9.275	9.200	43.125	4.75	42.750	4.50@4.75
2	9.275	9.250	44.000	4.75	.....	4.75
4	Holiday	9.250	Holiday	Holiday	Holiday	Holiday
5	9.525	9.625	43.500	4.75	42.750	4.75
6	9.525	9.625	43.500	4.90	42.750	4.75
7	9.525	9.625	43.800	4.90	42.750	4.75
8	9.525	9.275	42.700	4.90	42.750	4.75
9	9.525	9.300	42.750	4.90	.....	4.75
11	9.525	9.300	42.750	4.90	42.750	4.75
12	9.525	9.250	42.750	4.90	42.750	4.75
13	9.525	9.350	43.650	4.90	42.750	4.75
14	9.525	9.350	42.975	4.90	42.750	4.75
15	9.525	9.400	43.200	4.90	42.750	4.75
16	9.525	9.450	43.150	4.90	.....	4.75
18	9.525	9.525	43.125	4.90	42.750	4.75
19	9.525	9.575	43.350	4.90	42.750	4.75
20	9.525	9.650	43.500	4.90	42.750	4.75
21	9.525	9.625	43.500	4.90	42.750	4.75
22	9.650	9.700	43.500	4.90	42.750	4.75
23	9.650	9.775	43.625	4.90	.....	4.75
25	9.775	9.875	43.750	4.90	42.750	4.75
26	9.775	9.975	43.750	4.90	42.750	4.75
27	9.775	10.025	43.750	4.90	42.750	4.75
28	9.775	9.925	43.500	4.90	42.750	4.75
29	9.900	9.975	44.250	4.90	42.750	4.75
30	9.900	10.025	44.250	4.90	.....	4.75
High	**9.900**	**10.025**	**44.250**	**4.900**	**42.750**	**4.750**
Low	**9.275**	**9.200**	**42.700**	**4.750**	**42.750**	**4.500**
Average	**9.585**	**9.573**	**43.646**	**4.882**	**42.750**	**4.745**

AUGUST

Aug.	Copper Domestic	Copper Export	Tin	Lead	Silver	Zinc
1	9.900	9.975	43.900	4.90	42.750	4.75
2	9.900	10.025	43.700	4.90	42.750	4.75
3	9.900	10.075	43.650	4.90	42.750	4.75
4	9.900	10.025	43.500	4.90	42.750	4.75
5	9.900	10.025	43.500	4.90	42.750	4.75
6	9.900	10.025	43.750	4.90	.....	4.75
8	9.900	10.025	43.450	4.90	42.750	4.75
9	9.900	10.025	43.250	4.90	42.750	4.75
10	9.900	10.000	43.300	4.90	42.750	4.75
11	9.900	9.975	43.350	4.90	42.750	4.75
12	9.900	9.750	43.125	4.90	42.750	4.75
13	9.900	9.725	43.125	4.90	.....	4.75
15	9.900	9.675	43.000	4.90	42.750	4.75
16	9.900	9.650	42.900	4.90	42.750	4.75
17	9.900	9.675	43.175	4.90	42.750	4.75
18	9.900	9.675	43.000	4.90	42.750	4.75
19	9.900	9.700	43.000	4.90	42.750	4.75
20	9.900	9.700	43.000	4.90	.....	4.75
22	9.900	9.700	42.925	4.90	42.750	4.75
23	9.900	9.675	42.875	4.90	42.750	4.75
24	9.900	9.725	43.600	4.90	42.750	4.75
25	9.900	9.825	43.225	4.90	42.750	4.75
26	9.900	9.900	43.425	4.90	42.750	4.75
27	9.900	9.900	43.425	4.90	.....	4.75
29	9.900	9.825	42.800	4.90	42.750	4.75
30	9.900	9.775	43.250	4.90	42.750	4.75
31	9.900	9.725	43.250	4.90	42.750	4.75
High	**9.900**	**10.075**	**43.900**	**4.900**	**42.750**	**4.750**
Low	**9.900**	**9.650**	**42.800**	**4.900**	**42.750**	**4.750**
Average	**9.900**	**9.844**	**43.276**	**4.900**	**42.750**	**4.750**

SEPTEMBER

Sept.	Copper Domestic	Copper Export	Tin	Lead	Silver	Zinc
1	9.900	9.750	43.250	4.90	42.750	4.75
2	9.900	9.750	43.125	4.90	42.750	4.75
3	9.900	9.775	43.125	4.90	.....	4.75
5	Holiday	9.775	Holiday	Holiday	Holiday	Holiday
6	9.900	9.850	43.000	4.90	42.750	4.75
7	9.900	9.850	42.750	4.90	42.750	4.75
8	9.900	9.850	42.925	4.90	42.750	4.75
9	9.900	9.875	42.750	4.90	42.750	4.75
10	9.900	9.875	42.750	4.90	.....	4.75
12	9.900	9.900	42.750	4.90	42.750	4.75
13	9.900	9.900	42.650	4.90	42.750	4.75
14	9.900@10.025	9.950	42.900	4.90	42.750	4.75
15	10.025	10.000	43.350	4.95	42.750	4.75@4.85
16	10.025	10.100	43.500	5.00	42.750	4.85
17	10.025	10.125	43.500	5.00	.....	4.85
19	10.150	10.175	43.700	5.10	42.750	4.85@4.95
20	10.150	10.225	43.625	5.10	42.750	4.95
21	10.150	10.200	43.700	5.10	42.750	4.95
22	10.150	10.025	43.375	5.10	42.750	4.95
23	10.150	9.950	43.250	5.10	42.750	4.95
24	10.150	9.925	43.250	5.10	.....	4.95
26	10.150	9.900	43.750	5.10	42.750	4.95
27	10.150	9.925	44.125	5.10	42.750	4.95
28	10.150	9.775	44.250	5.10	42.750	4.95
29	10.150	10.000	44.375	5.10	42.750	4.95
30	10.150	10.100	44.500	5.10	42.750	4.95
High	**10.150**	**10.225**	**44.500**	**5.100**	**42.750**	**4.950**
Low	**9.900**	**9.750**	**42.650**	**4.900**	**42.750**	**4.750**
Average	**10.028**	**9.943**	**43.369**	**4.998**	**42.750**	**4.846**

OCTOBER

Oct.	Copper, Electrolytic Domestic	Copper, Electrolytic Export	Tin, Straits, New York	Lead, Common, New York	Silver, New York	Zinc, Prime Western E. St. Louis
1	10.150	10.125	44.500	5.10	.....	4.95
3	10.150	10.075	43.500	5.10	42.750	4.95
4	10.150	10.075	43.500	5.10	42.750	4.95
5	10.150@10.275	10.150	43.750	5.10	42.750	4.95
6	10.275@10.400	10.375	45.125	5.10	42.750	4.95
7	10.400	10.425	44.700	5.10	42.750	4.95
8	10.400	10.425	44.700	5.10	.....	4.95
10	10.525	10.600	45.000	5.10	42.750	4.95
11	10.525	10.700	44.750	5.10	42.750	4.95
12	Holiday	10.700	Holiday	Holiday	Holiday	Holiday
13	10.775	10.825	45.225	5.10	42.750	4.95@5.05
14	11.025	11.025	45.475	5.10	42.750	5.05
15	11.025	11.125	45.500	5.10	.....	5.05
17	11.025	11.125	45.250	5.10	42.750	5.05
18	11.025	10.800	45.250	5.10	42.750	5.05
19	11.025	10.900	45.700	5.10	42.750	5.05
20	11.025	10.825	45.250	5.10	42.750	5.05
21	11.025	10.800	45.500	5.10	42.750	5.05
22	11.025	10.800	45.600	5.10	.....	5.05
24	11.025	10.875	45.950	5.10	42.750	5.05
25	11.025	10.925	46.350	5.10	42.750	5.05
26	11.025	11.025	46.250	5.10	42.750	5.05
27	11.025	11.025	46.400	5.10	42.750	5.05
28	11.025	11.025	46.000	5.10	42.750	5.05
29	11.025	11.000	46.250	5.10	.....	5.05
31	11.025	10.800	46.100	5.10	42.750	5.05
High	**11.025**	**11.125**	**46.400**	**5.100**	**42.750**	**5.050**
Low	**10.150**	**10.075**	**43.500**	**5.100**	**42.750**	**4.950**
Average	**10.760**	**10.713**	**45.263**	**5.100**	**42.750**	**5.012**

NOVEMBER

Nov.	Copper Domestic	Copper Export	Tin	Lead	Silver	Zinc
1	11.025	10.800	46.350	5.10	42.750	5.05
2	11.025	10.800	46.100	5.10	42.750	5.05
3	11.025	10.775	46.375	5.10	42.750	5.05
4	11.025	10.800	46.350	5.10	42.750	5.05
5	11.025	10.800	46.275	5.10	.....	5.05
7	11.025	10.800	46.250	5.10	42.750	5.05
8	Holiday	10.850	Holiday	Holiday	Holiday	Holiday
9	11.025	10.900	46.500	5.10	42.750	5.05
10	11.025	10.975	46.700	5.10	42.750	5.05
11	Holiday	10.925	Holiday	Holiday	Holiday	Holiday
12	11.025	10.925	46.850	5.10	.....	5.05
14	11.025	10.850	46.750	5.10	42.750	5.05
15	11.025	10.675	46.450	5.10	42.750	5.05
16	11.025	10.675	46.550	5.10	42.750	5.05
17	11.025	10.425	46.300	5.10	42.750	5.05
18	11.025	10.425	46.250	5.10	42.750	5.05
19	11.025	10.425	46.250	5.10	.....	5.05
21	11.025	10.300	46.100	5.10	42.750	4.75
22	11.025	10.250	45.925	5.10	42.750	4.75
23	11.025	10.325	46.100	5.10	42.750	4.75
24	Holiday	10.350	Holiday	Holiday	Holiday	Holiday
25	11.025	10.400	46.000	5.10	42.750	4.75
26	11.025	10.350	45.800	5.10	.....	4.75
28	11.025	10.025	45.700	5.10	42.750	4.75
29	11.025	9.975	45.850	5.00	42.750	4.50
30	11.025	10.000	46.250	5.00	42.750	4.50
High	**11.025**	**10.975**	**46.850**	**5.100**	**42.750**	**5.05**
Low	**11.025**	**9.975**	**45.700**	**5.000**	**42.750**	**4.50**
Average	**11.025**	**10.569**	**46.262**	**5.091**	**42.750**	**4.924**

DECEMBER

Dec.	Copper Domestic	Copper Export	Tin	Lead	Silver	Zinc
1	11.025	10.075	46.200	5.00	42.750	4.50
2	11.025	10.000	45.850	5.00	42.750	4.50
3	11.025	9.975	45.850	5.00	.....	4.50
5	11.025	9.875	46.000	5.00	42.750	4.50
6	11.025	9.875	46.250	4.85	42.750	4.50
7	11.025	10.025	46.500	4.85	42.750	4.50
8	11.025	10.025	46.125	4.85	42.750	4.50
9	11.025	9.975	45.850	4.75	42.750	4.50
10	11.025	9.950	45.950	4.75	.....	4.50
12	11.025	9.950	46.000	4.75	42.750	4.50
13	11.025	9.950	46.000	4.75	42.750	4.50
14	11.025	9.950	46.000	4.75	42.750	4.50
15	11.025	10.025	46.350	4.75	42.750	4.50
16	11.025	10.075	46.000	4.75	42.750	4.50
17	11.025	10.075	46.000	4.75	.....	4.50
19	11.025	10.050	46.000	4.85	42.750	4.50
20	11.025	10.050	46.000	4.85	42.750	4.50
21	11.025	10.050	46.000	4.85	42.750	4.50
22	11.025	10.025	46.250	4.85	42.750	4.50
23	11.025	10.025	46.350	4.85	42.750	4.50
24	11.025	10.025	46.350	4.85	.....	4.50
26	Holiday	Holiday	Holiday	Holiday	Holiday	Holiday
27	11.025	10.075	46.350	4.85	42.750	4.50
28	11.025	10.075	46.500	4.85	42.750	4.50
29	11.025	10.125	46.700	4.85	42.750	4.50
30	11.025	10.150	46.650	4.85	42.750	4.50
31	11.025	10.150	46.600	4.85	.....	4.50
High	**11.025**	**10.150**	**46.700**	**5.000**	**42.750**	**4.500**
Low	**11.025**	**9.875**	**45.850**	**4.750**	**42.750**	**4.500**
Average	**11.025**	**10.023**	**46.180**	**4.850**	**42.750**	**4.500**

E & M J
Annual Average Metal Prices 1897-1938

Year	Copper (a) Electrolytic, Refinery	Tin, (b) New York	Lead Common, New York	Silver New York	Zinc, Prime Western (d) E. St. Louis
1897	11.29	13.67	3.58	59.790	4.12
1898	12.03	15.70	3.78	58.260	4.57
1899	16.67	25.12	4.47	59.580	5.75
1900	16.19	29.90	4.37	61.330	4.39
1901	16.11	26.74	4.33	58.950	4.07
1902	11.626	26.79	4.069	52.160	4.84
1903	13.235	28.09	4.237	53.570	5.191
1904	12.823	27.99	4.309	57.221	4.931
1905	15.590	31.358	4.707	60.352	5.730
1906	19.278	39.819	5.657	66.791	6.048
1907	20.004	38.166	5.325	65.237	5.812
1908	13.208	29.465	4.200	52.864	4.578
1909	12.982	29.725	4.273	51.502	5.352
1910	12.738	34.123	4.446	53.486	5.370
1911	12.376	42.281	4.420	53.340	5.608
1912	16.341	46.096	4.471	60.835	6.799
1913	15.269	44.252	4.370	59.791	5.504
1914	13.602	34.301 (c)	3.862	54.811	5.061
1915	17.275	38.590	4.673	49.684	13.054
1916	27.202	43.480	6.858	65.661	12.634
1917	27.180	61.802	8.787	81.417	8.813
1918	24.628	88.750	7.413	96.772	7.890
1919	18.691	63.328	5.759	111.122	6.988
1920	17.456	48.273	7.957	100.900	7.671
1921	12.502	29.916	4.545	62.654	4.655
1922	13.382	32.554	5.734	67.528	5.716
1923	14.421	42.664	7.267	64.873	6.607
1924	13.024	50.176	8.097	66.781	6.344
1925	14.042	57.893	9.020	69.065	7.622
1926	13.795	65.285	8.417	62.107	7.337
1927	12.920	64.353	6.755	56.370	6.242
1928	14.570	50.427	6.305	58.176	6.027
1929	18.107	45.155	6.833	52.993	6.512
1930	12.982	31.694	5.517	38.154	4.556
1931	8.116	24.467	4.243	28.700	3.640
1932	5.555	22.017	3.180	27.892	2.876
1933	7.025	39.110	3.869	34.727	4.029
1934	8.428	52.191	3.860	47.973 (e)	4.158
1935	8.649	50.420	4.065	64.273 (e)	4.328
1936	9.474	46.441	4.710	45.087 (e)	4.901
1937	13.167	54.337	6.009	44.883 (e)	6.519
1938	10.000	42.301	4.739	43.225 (e)	4.610

(a) Lake copper 1897 and 1898; domestic copper only since 1932. (b) 99 per cent tin, 1897 to 1920, inclusive; Straits tin thereafter. (c) Average for eleven months. (d) New York zinc 1897 to 1902, inclusive. (e) Other than newly mined domestic.

Prices are in cents per pound, except those for silver, which are in cents per troy ounce.

Zinc

(*Continued from page* 41)

the world situation, the fact that foreign zinc ore production is, in many cases, treated as a byproduct and that, consequently, zinc is sold for whatever price it will bring, cannot be overlooked. And countries striving for self-sufficiency contribute a recent and largely uneconomical production to the enormous tonnage of metal pressing for outlets in the few remaining free markets. Referring to past years, the Bureau of Mines states: "The tariff barrier was all that prevented dumping all distress foreign metal on the United States market that would have reacted to the detriment of the American producers."

The reduction in the duty of zinc metal from 1.75c. to 1.40c. a pound intensifies the competition from foreign zinc which has been threatening even under the existing tariff rates. In general, the price of zinc in this country, as long as the producers can stand it, must be and will be such as to keep out foreign metal. The reduction in the duty reduces this price by $7 a ton, a substantial handicap. Thus, it is only when United States production may be unable to take care of requirements of American industry that the reduction in duty can be of value to foreign producers. This situation has existed for only one month since the World War. And during this period domestic prices of zinc were not particularly burdensome on domestic consumers, and some foreign metal came into the country at the existing duty.

Because of our lack of experience with foreign competition, it is impossible to forecast the situation clearly. It becomes further involved by the unpredictable nature of European events, both business and political. Obviously, however, though domestic business may continue to improve, strengthening of zinc prices cannot be looked for unless foreign conditions and the foreign zinc market improve, and, as indicated in the foregoing, prospects for such improvement are not bright. In other words, though the domestic business situation will determine the volume of sales, the foreign situation will determine the price of zinc metal and, consequently, the health of the zinc industry.

Tin

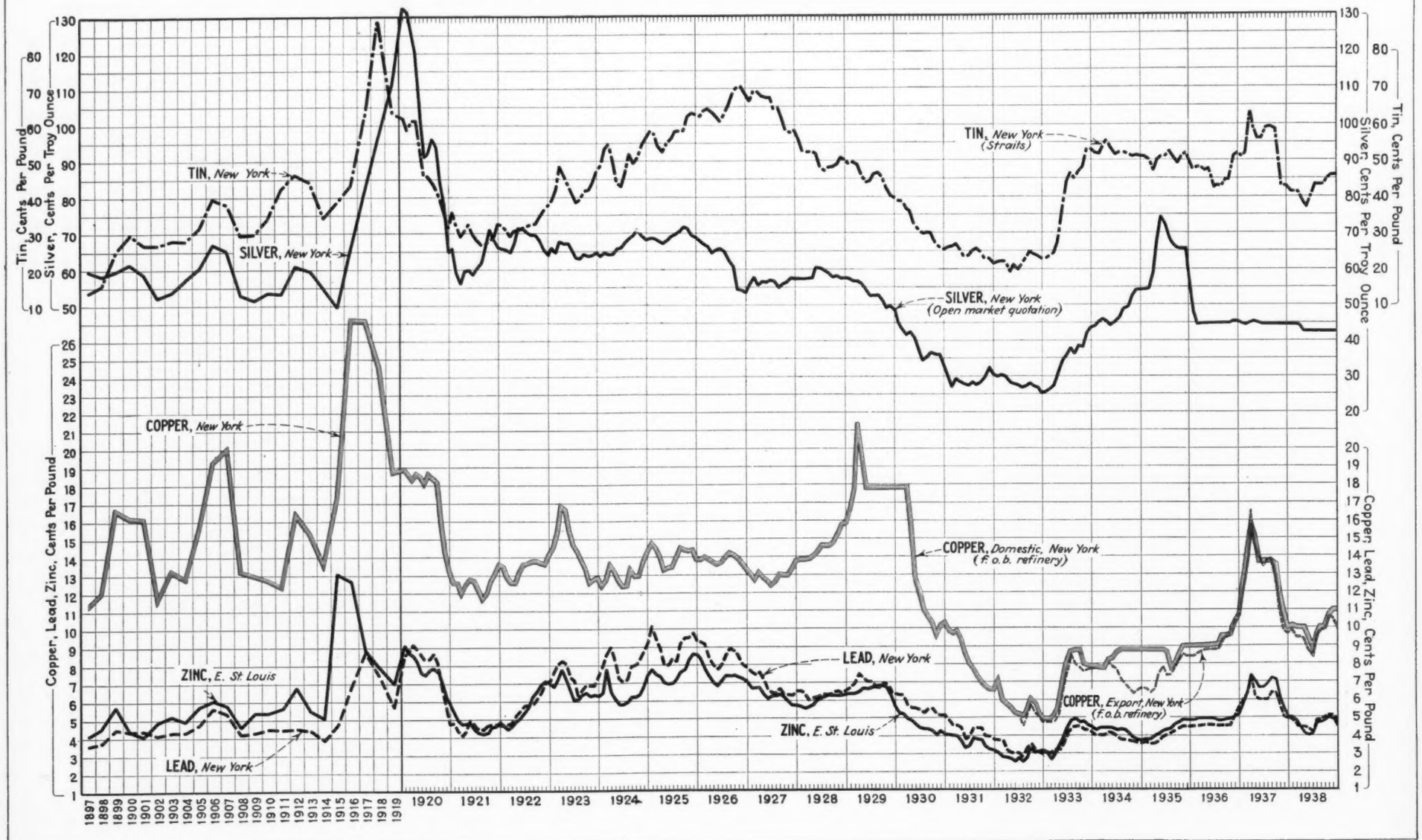
(*Continued from page* 42)

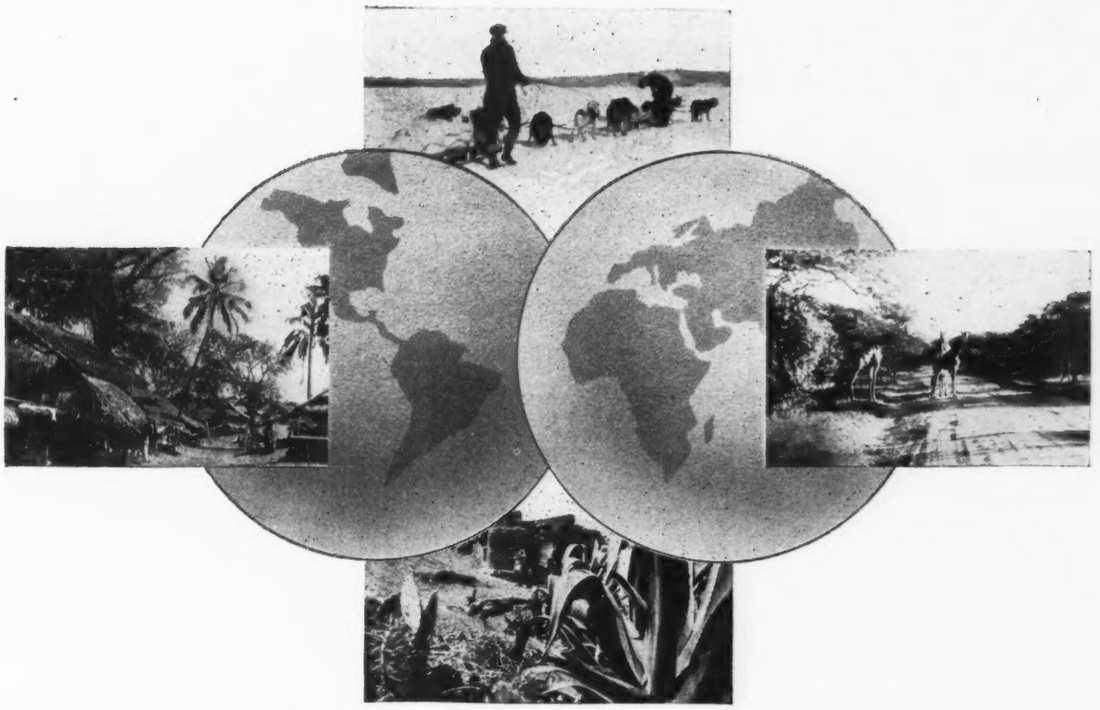
cy of supply of say 14,000 tons. This deficiency was no doubt met by supplies of secondary tin and a reduction in invisible supplies. The consumption of secondary metal in the United States in 1937 was computed by the Bureau of Mines at 17,200 tons. There is no doubt that there was a large accumulation of tin in the United States at the beginning of 1938. The tin-plate mills are said to have had 78 per cent more tin on hand at the beginning of the year than twelve months earlier, and this with the secondary tin available has certainly enabled them to conduct operations without difficulty in a year when consumption has been considerably reduced. How long this condition will continue is one of the chief problems for the tin Control in the coming months. How far the building up of strategic reserves has entered into consumption figures it is impossible to judge. What must be equally conjectural is what loss in consumption must be allowed for in respect of the substitution of tin by other substances, which has been going on for some years. When the 1938 figures are fully available it may be possible to judge these problems more closely.

Looking at the prospects for 1939, it is not possible, at the moment, to do more than reflect the present market opinion, which is that, provided the present scheme for the operation of the buffer pool and the regulation of quotas to make it effective is observed without evasion or modification, the price of the metal will tend to advance until the figure is reached at which the Controller of the buffer pool elects to liquidate; in short, that the design of stabilizing tin between £200 and £230 may be effective during the continuation of the present agreement. There is, however, evidence of considerable dissatisfaction with the hampering effect of the agreement on the industry in Malaya, Bolivia, and among the Banka interests. There are bound to be dissatisfied minorities, and as long as they remain minorities the scheme should continue to function.

E & M J METAL PRICES 1897-1938

(Annual averages 1897 to 1919—monthly averages 1920 to 1938)


Tin, Cents Per Pound
Silver, Cents Per Troy Ounce
Copper, Lead, Zinc, Cents Per Pound
TIN, New York
SILVER, New York
TIN, New York (Straits)
SILVER, New York (Open market quotation)
COPPER, New York
COPPER, Domestic, New York (f. o. b. refinery)
LEAD, New York
ZINC, E. St. Louis
COPPER, Export, New York (f. o. b. refinery)
1897 1898 1899 1900 1901 1902 1903 1904 1905 1906 1907 1908 1909 1910 1911 1912 1913 1914 1915 1916 1917 1918 1919 1920 1921 1922 1923 1924 1925 1926 1927 1928 1929 1930 1931 1932 1933 1934 1935 1936 1937 1938



Events in

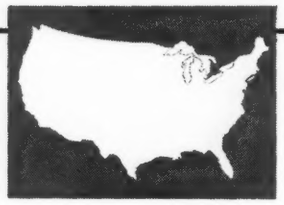
A World Wide Field

ONLY A BROAD VIEW and a wide outlook can compass the field of mining. Stretching in latitude from the Arctic to the tropics, and from the Philippines and Australia and the islands of the Pacific eastward across the Americas to Africa and back to the Orient again, it embraces all climates and many peoples, with political and economic systems as varied. In short, it covers the earth.

World wide though this industry be, many common interests knit its units closely. A survey of the situation in the major mining countries during 1938, so far as the facts could be learned, is presented in the following pages. The operating picture has its bright spots and its shadows. The important gold areas enjoyed prosperity, with activity on the increase, and wherever that precious metal occurred with others it proved a welcome sweetener. For miners of other products the situation was less simple, though not devoid of high lights.

Outstanding in the Western Hemisphere, Canada continued to provide new thrills and Mexico new shivers, for those anxious for the latter country's welfare. Across the water, the Dark Continent appears to need re-naming, as Southern and Central Africa shine ever brighter in new performance. The world-wide view shows politics and economics, inextricably mixed, bedeviling what might otherwise be a happy situation.

United States



Industrial recession during the first half of the year forces sharp drop in the domestic base-metal output. Steady improvement marked last six months

H. C. Chellson
Assistant Editor

MINING was not as active, and operators were not as cheerful, in 1938 as in 1937. Given a lower price of silver to start the year, and a decline of general industrial activity, the mining industry experienced lower metal prices, reduced wages, and more unemployment during the first half of the year. A low point was reached in summer, when many large copper mines virtually shut down. Production of all metals except gold, therefore, declined sharply for the year.

A reversal in this downward trend of industrial activity started in the summer and effectively reached the mining industry in the last quarter. Demand for metals increased, mines reopened, and employment gained 2.4 per cent in December, reaching 62.7 per cent, against 70.4 per cent for the same period in 1937. Low metal prices, however, kept payrolls in December at 54.4 per cent of the 1929 average against 65.1 per cent in December, 1937.

As the industry was enjoying this respite from the recession, an announcement from Washington, in November, brought a lower tariff on zinc, effective Jan. 1, 1939. Domestic zinc prices dropped quickly and zinc mines soon felt the shock of this new duty, in terms of curtailment and unemployment.

Larger gold production was due to expansion at operating mines, and more large gold dredges in some Western States. Of interest is the sharp increase in gold production in South Carolina and Washington. Statistics by the Bureau of Mines reveal the leading metal-producing States in 1938.

California—In 1938 California produced about 1,294,400 oz. of gold. This output was a new record since 1862 and is well above the 1,174,578 oz. produced in 1937. Mine examinations, prospecting, development of larger ore reserves in scattered mining areas of the State during the last few years are rapidly being translated into terms of greater gold production, and as long as new properties exceed those worked out, and operations are not further disturbed by new laws, taxes, and labor trouble, gold production is likely to increase.

The most productive district was the Grass Valley - Nevada City, where mines of the Empire Star Mines Company, the Empire Pennsylvania, North Star, Murchie, and Zeibright accounted for a large part of the State's output. The Idaho Maryland Mines Corporation, with its Brunswick properties, also in the Grass Valley-Nevada City district, Nevada County, and its properties in the Forbestown district, was the State's second largest gold producer. Other important producers were Lava Cap Gold Mining Corporation, Golden Center mine, Bradley Mining Company, and properties in the Grass Valley-Nevada City district. On the Mother Lode, the Argonaut and Kennedy mines were the leading producers, others being Central Eureka Mining Company, Mountain Copper Company, Ltd., and the Carson Hill Gold Mining Corporation, accounting for a large output from low-grade ores. Development at small properties in the Mojave district may account for a growing output from this district; meanwhile properties here, such as the Golden Queen Mining Company, Benton Bros. Inc., Cactus Queen Mining Company, and the Lodestar Mining Company, accounted for a fair production at the southern end of the Mother Lode.

Among producers of placer gold the Natomas Company, Capital Dredging Company, Consumnes Gold Dredging Company, and Yuba Consolidated Gold Fields accounted for the major output. Numerous dragline dredges, especially in Shasta County, contributed a fair part of the 1938 production.

Silver output was slightly below that of the previous year, being 2,755,000 oz., against 2,888,265 oz. in 1937. The Mojave district accounted for a large part of this total. Walker Mining Company, operating in the latter part of the year, produced some silver, but gold mines accounted for most of the silver produced, it being recovered as a byproduct.

California's leading copper producer, the Walker mine, in Plumas County, produced little metal, as operations continued for only two months during the year. Lead and zinc were produced in small quantities as byproducts of gold ore.

Arizona—Gold production in 1938 declined slightly, due to a lower rate of operations of the copper mines that produce gold as a byproduct. Recovery from placer operations, however, was above that of the previous year, being 4,800 oz., against 4,399 oz. Total gold production in the State was 310,000 oz. in 1938, against 332,694 in the previous year. About half of the total production came from the Copper Queen, United Verde, Gold Road, and New Cornelia mines. The only district that showed an increase in gold production from lode mines was the Old Hat, whose output increased 9,115 oz., or above 1937, according to the Bureau of Mines.

Mines that accounted for a good volume of the gold output were Mammoth-St. Anthony, Gold Standard, Octave, Tennessee-Schuylkill, Magma, New Year-Mohawk, Hillside, Tom Reed, Iron King, Eagle-Picher, Denn, Pilgrim, Alvarado, Lake Superior & Arizona, and the Golden Turkey.

Silver production declined from 9,422,552 oz. in 1937 to 7,600,264 oz. in 1938. About half of this output came from the Copper Queen and United Verde mines of the Phelps Dodge Corporation. Production decreased in all districts except the Ash Peak, where output was 517,582 oz., against 465,382 oz. in the previous year. Principal silver producing mines were the Eagle-Picher, Ash Peak, Magma, New Cornelia, Reymert, Arizona Magma, Alpha-Keystone, Denn, and properties in Tombstone.

Arizona was again the nation's largest copper-producing State, where 207,750 tons of copper were mined in 1938, against 288,478 tons in the previous year. The New Cornelia mine was the largest producer, others being the Copper Queen, United Verde, Miami, Inspiration, Magma, Nevada Consolidated, and Morenci properties. Smaller producers were the Denn, Arizona Molybdenum, and United Verde Extension.

The Bureau of Mines reports that 55 per cent of the lead produced in Arizona in 1938 was recovered from zinc-lead ore and the remainder came principally from gold ore and lead ore. The largest individual lead producer in the State was the Eagle-Picher Mining & Smelting Company, followed by the Tennessee-Schuylkill,

Mammoth, St. Anthony, New Year-Mohawk, Hillside, Tombstone, and "79" mines. Estimated production of lead in Arizona in 1938 is 10,300 tons, against 12,359 tons in 1937.

Production of zinc increased during 1938, total output being 5,300 tons, against 5,026 tons in the previous year. Most of the zinc came from the Montana mine of the Eagle-Picher Mining & Smelting Company, the Tennessee-Schuylkill, at Chloride, and the Magma copper mine, at Superior. During 1938 production from a zinc-copper orebody at the Magma mine was treated in a 250-ton flotation plant that was completed late in 1937.

Utah—Low metal prices and curtailed production in all Utah mining districts resulted in the lowest value of metal output since 1935. Gold production was around 210,650 oz., against 322,759 oz. in 1937. This drop was principally due to curtailed operations by Utah Copper Company, the largest copper ore producer which makes it the largest gold producer as well. Closing of the Silver King Coalition and Park Utah Consolidated mines also was a factor in lower output. Opposing this downward trend was the Consolidated Mercur and Geyser Marion properties, at Mercur, where gold production doubled that of 1937. The Bureau of Mines reports ten properties yielded about 85 per cent of the total gold produced in the State in 1938. The leading producers were Utah Copper Company, followed by the United States & Lark, Consolidated Mercur, Chief, Mammoth, and Eureka Standard mine.

The cut in the price of silver from 77.35c. to 64.64c. per ounce for 1938 brought a reduction in value of silver output from $9,954,262 in 1937 to $6,225,269 in 1938. The leading silver producer was again the United States & Lark mines at Bingham, followed by Tintic Standard, Park City Consolidated, Utah Copper, and Silver King Coalition (closed on April 30, 1938). These mines produced about 70 per cent of the total silver. The Park City Consolidated and New Park mines nearly doubled their 1937 silver output.

The nation's largest copper producer, Utah Copper Company, produced only a little more than half of its 1937 output. During the summer there was a complete shutdown at the company's open-cut mine, and the Magma and Arthur mills were closed, due to the light demand for copper. Lower prices for copper, forcing the curtailed output, accounted for 66 per cent of the total decrease in value of the five metals produced in the State.

Production of lead decreased from 89,458 tons in 1937 to 61,038 tons in 1938, or about 26 per cent. Reduction in value amounted to about 46 per cent, or from $10,556,044 in 1937 to $6,207,572 in 1938. Most of this decline occurred in the Park City region, due to early closing of the Silver King Coalition and Park Utah Consolidated mines.

Zinc production declined 29 per cent, most of the loss occurring in the Park City region, where the ore contains lead and zinc. Total output was 34,186 tons, against 48,000 tons in 1937.

Montana—Metal production in Montana declined sharply during 1938 for a number of reasons, chief of which were low metal prices, and labor difficulties at the East Helena smelter that eventually suspended mining at gold and base-metal mines in various districts.

Gold production decreased from 202,252 oz. to 197,200 in 1938. Curtailment by the Anaconda Copper Mining Company at its copper and zinc units also resulted in less gold produced. At the Jardine, Little Bear, Ruby Gulch, and Spring Hill lode mines production of gold also declined. At five properties, however, output increased over that of the previous year; they were the West Mayflower, Butte Highlands, Golden Messenger, Keating, and Liberty mines.

Suspension of operations by Humphreys Gold Corporation on Clancey Creek was responsible for a decline in gold production from placers during the year. Increases were made, however, by Winston Bros. Gold Creek Mining Company, and others. Three new dredges started operations during the year—two in the summer and one late in the year. In August, Winston Bros. commenced operations of a bucket-line dredge on Prickly Pear Creek, and a floating dredge operated by the Gold Creek Mining Company started operations on Washington Bar, in Madison County. In December the Perry-Schroeder Corporation started operations of a large bucket-line dredge on Hauser Lake. Several dragline placer mining units also commenced operations during 1938. The leading gold producer during the year was the West Mayflower mine of the Anaconda Copper Company.

Silver production dropped from 11,812,093 oz. to 6,306,792 oz., or about 47 per cent, in 1938. Curtailment of operations by Anaconda Copper Mining Company at Butte in copper production accounted for the sharp decline in silver. In the Neihart district lead mines containing silver were restrained from shipping their ores to the East Helena lead plant due to the smelter strike, thereby accounting in measure for a decline in silver output.

Copper production, virtually all from the Butte mines of the Anaconda Copper Mining Company, declined from 144,528 tons to 76,943 tons in 1938. The general business recession caused this sharp curtailment, and at one time operations were running at one-eighth of capacity. Production steadily increased, however, during the last quarter of the year.

Lead production was about half of that produced in the previous year. Output last year was 8,614 tons, against 17,957 in 1937. The effects of curtailment at the Orphan Girl and Emma mines of the Anaconda Copper Mining Company accounted in large

Principal United States Production of Gold, Silver, Copper, Lead and Zinc

(United States Bureau of Mines)

Mine production of metals in 1937 and 1938 in terms of the recovered and recoverable metal in ounces and short tons. Figures for 1938 estimated.

Western States	Gold, Oz.		Silver, Oz.		Copper, Tons		Lead, Tons		Zinc, Tons	
	1937	1938	1937	1938	1937	1938	1937	1938	1937	1938
Arizona	332,694	310,000	9,422,552	7,600,264	288,478	207,750	12,354	10,300	5,026	5,300
California	1,174,578	1,294,400	2,888,265	2,755,000	5,251	1,105	1,186	500	20	10
Colorado	368,905	370,100	6,260,693	7,776,600	10,934	13,545	9,786	9,878	4,247	4,659
Idaho	81,861	101,000	19,587,766	18,601,127	2,232	2,100	103,711	90,500	54,199	43,500
Montana	202,252	197,200	11,812,093	6,306,792	144,528	76,943	17,957	8,614	39,168	7,705
Nevada	281,332	289,700	4,864,750	4,078,000	74,603	48,930	9,347	4,550	14,236	9,455
New Mexico	41,171	38,600	1,243,766	1,015,200	32,053	17,547	6,512	4,743	23,927	25,977
Oregon	52,662	77,100	60,564	105,000	410	46	109	23	24	.....
South Dakota	581,544	594,000	139,638	160,000	.....	.....	.....	.....	.....	.....
Texas	562	455	1,325,660	1,445,100	160	17	395	354	.....	.....
Utah	322,759	210,650	12,869,117	9,629,713	205,994	107,899	89,458	66,038	48,001	34,186
Washington	36,310	73,400	126,304	290,582	64	5,872	2,830	4,143	4,116	11,397
Wyoming	1,776	877	203	400	.....	.....	.....	.....	.....	.....
Central States	51	.....	206,041	214,973	47,733	46,700	204,885	157,185	244,045	196,220
Eastern States	10,681	19,221	106,873	83,085	12,222	9,701	5,539	7,544	189,353	170,459
Alaska	627,940	667,000	494,340	500,800	17,336	14,390	823	985	.....	.....
Totals	4,117,078	4,243,703	71,408,625	60,562,636	841,998	552,545	464,892	365,357	626,362	508,868

measure for the decline in mine output of lead. Less production from the Jack Waite, Comet, and Trout mines also accounted for the decline.

Zinc production was estimated at 7,705 tons, against 39,168 tons in 1937. Virtually the same mines responsible for the decline in lead output also accounted for the drop in zinc output, as the ores produced contained both metals.

Idaho—Output of silver, for which Idaho is known, declined 986,639 oz. to 18,601,127 oz. in 1938, against 19,587,766 oz. in 1937. Lower metal prices forced curtailment at large mines in the Coeur d'Alene region, thereby decreasing the total value of metal output by 24 per cent from the figures for 1937.

Gold production increased at placer mines, which accounted for a higher total output than in 1937. About 33,800 oz. were recovered by nine bucket-type dredges, and 17,200 oz. by several dragline units. In 1937, ten bucket dredges recovered 28,962 oz. and dragline dredges produced 6,859 oz. Large dredge operations in the Boise Basin district recovered nearly one-third of the State's gold output. These were the Fisher & Baumhoff dredges at Centerville, Moores Creek Dredging Company and the Warren Dredging Company, Ferris & Marchbank dragline on Newsome Creek and Jordan Creek Placers, and among the lode mines were the Triumph, Mayflower, and Yellow Pine at Stibnite.

The largest silver producer was the Sunshine Mining Company, near Kellogg, followed by the Polaris, Hecla, Bunker Hill & Sullivan, Triumph, Morning Crescent, Page, Clayton, and Sherman mines.

Idaho's copper production came principally as a byproduct of silver ore produced at the Sunshine, Polaris, and Crescent mines and from zinc-lead mines such as Bunker Hill & Sullivan, Triumph, Morning, and Hecla. Output was 2,100 tons, against 2,232 tons in 1937.

Lead production declined 13 per cent during 1938 from 103,711 tons in 1937 to 90,500 tons. The large lead mines in Idaho also produce large quantities of zinc and are, therefore, more commonly known as lead-zinc mines. Lead, however, is the predominant metal. Production of zinc was 43,500 tons, against 54,199 tons in 1937. The major producers of these metals are Bunker Hill & Sullivan, Hecla, Morning, Triumph, Page, Star, Sherman, Frisco, and Gold Hunter mines. The Bunker Hill & Sullivan was the largest lead producer, whereas the Morning mine was the largest producer of zinc.

Colorado—Precious- and base-metal production from this State's diversified mineral deposits had a total value of $22,020,731 in 1938, against $22,107,207 in 1937. Based on volume of metals produced, it was higher than in 1937, but lower metal prices reduced the value slightly under that of 1937.

Gold production totaled 370,100 oz., of which placer mines yielded approximately 17,500 oz., that came from an estimated 600 operations during the year. This compares with 14,871 oz. from 490 placer operations in 1937. The Cripple Creek district had three properties that produced the most gold, the Cresson Consolidated Gold Mining & Milling Company, United Gold Mines Company, and the Golden Cycle Ajax operations. Deep development in the Golden Cycle group revealed additional ore last year.

Silver from mines in Eagle County supplied the major production in the State. The orebodies in the Eagle mine of the Empire Zinc Division subsidiary of the New Jersey Zinc Company accounted for most of the output. Total silver production for the State in 1938 was around 7,776,600 oz., against 6,260,693 oz. in 1937. Many mines in the State produced silver with other metals.

Copper output showed an increase in 1938, production being 13,545 tons, against 10,934 tons in 1937. The Eagle mine, operated by the Empire Zinc Division of the New Jersey Zinc Company, accounted for most of this.

The San Juan region, in southwestern Colorado, produced the largest amount of lead and zinc. A large producer of lead was the Sunnyside Mining & Milling Company, operating the Sunnyside mine, which was shut down June 1, 1938. The Shenandoah-Dives Mining Company produced a substantial volume of lead and this would have been higher but for a snowslide that damaged the company's aerial tram connecting mine and mill. Mines in Lake, San Miguel, and San Juan counties also were important lead producers. Total production of lead in Colorado during 1938 was 9,878 tons, against 9,786 tons in 1937.

Following San Juan County in zinc production was Lake County. Zinc production in the former was very close to the volume of lead produced. Some of the zinc producers in San Juan besides those already mentioned are the Bandora, Brooklyn, Champion, Copper Bell group, Ezra R. group, Highland Mary, and Kankakee.

Zinc production was 4,659 tons in 1938, against 4,247 tons in 1937.

The Climax Molybdenum Company, at Climax, Lake County, produced about 28,150,000 lb. of elemental molybdenum in 1938. Tungsten mines in Boulder County were more active and vanadiam production at Uraven continued through the year. The estimated value of molybdenum, tungsten, and vanadium production (largely used in alloy steels) in Colorado in 1938 was about $21,000,000.

Nevada—The feature of metal production in Nevada during 1938 was the return of gold to first place as the most valuable mineral produced. During 1936 and 1937 copper led the list. Gold production in 1938 exceeded that for any year since 1918, and the increase was due to greater output of dry and siliceous ores. Most of Nevada's gold came from lode mines, but some came from the dragline operations of the Mill Gulch Placer Mining Company in Lander County. A new, bucket-type gold dredge of the Manhattan Gold Dredging Company started operations late in the year and aided in boosting the total output. Nevada Consolidated Copper Corporation and the Consolidated Coppermines Corporation were among the largest gold producers in the State. The largest gold producer in 1938 was the Black Mammoth Consolidated Mining Company, followed by the Getchell mine. Total gold production in 1938 was 289,700 oz., against 281,332 oz. in 1937.

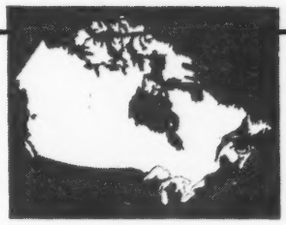
Silver output declined largely, due to closing in 1937 of the Treadwell Yukon Company's mine in the Tybo district, which was also a substantial producer of lead and zinc. Silver occurring as a byproduct in copper ores of the Nevada Consolidated Copper Corporation was produced in lesser amounts, due to curtailment of copper production. The leading silver producer in 1938 was Desert Silver, Inc., in the Silver Peak district, Esmeralda County. Other silver producers were Consolidated Coppermines, Combined Metals Reduction Company, and Tonopah, Belmont Development Company. Total silver production in 1938 was 4,078,000 oz., against 4,864,750 tons in 1937.

Copper production declined sharply, due to curtailment and lower metal prices. Nevada Consolidated Copper Corporation at one time shut down operations and resumed on a curtailed basis late in the year. Consolidated Coppermines Corporation produced ore from blocks containing copper and precious metals, the total output being approximately 6,000 tons of ore per day.

The Mountain City Copper Company remained shut down a good part of the year, but resumed late in 1938 and therefore produced little copper.

The Pioche district, Lincoln County, accounted for virtually all of the lead and zinc produced in the State during the year. The principal producer was the Combined Metals Reduction Company, followed by Pioche Mines Consolidated and Yellow Pine Development Company in Clark County. Small scattered shipments of lead and zinc ore occurred during the year, but activity in this direction was curtailed due to low metal prices.

Canada



Expansion in gold mining greatest in Dominion's history. Forty new mines to build mills. Copper, zinc, lead outputs at new peak

John B. DeMille

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WITH only minor recessions in nickel output and structural materials, the Canadian mining industry in 1938 enjoyed prosperity, the production of gold being unprecedented. Copper, lead, and zinc also were produced in greater quantities than ever before. The total value of mineral production for the year is estimated at $440,634,000, down 4 per cent from 1937 ($457,359,092).

At the end of 1938 approximately 166 gold mines were in regular production, with a combined daily capacity of more than 50,000 tons of ore. Production in 1930 came from only 31 mines throughout the Dominion. Last year 39 producers were added to the list, and at least 40 more are now scheduled to complete mills in 1939. Many of the established producers plan to increase their capacity.

Gold production up to the end of October shows that each successive month up to August saw a new record, and in all months the output exceeded the 1937 figures. Bullion recovered in the first ten months amounted to 3,871,956 oz., compared with 3,380,735 oz. in the same period of 1937. Value of the output for the year is estimated at $164,561,000, compared with $143,326,493 in 1937.

Six Canadian mines are among the 30 largest gold producers of the world. They are: Lake Shore (11th place), Hollinger (13th), Noranda (17th), McIntyre Porcupine (25th), Wright-Hargreaves (26th), and Dome.

Mines in the Dominion are now supplying 12 per cent of world consumption of both copper and lead and 13 per cent of the zinc. Canada stands in second place in the world in the production of zinc and third in gold, copper, and silver. In nickel the output from the Sudbury area amounts to more than 90 per cent of world requirements. Refineries and fabricating plants have been keeping pace with mine output.

The value of all non-metallic minerals, except structural materials, produced in 1938 showed slight change at $87,465,000, compared with $88,324,150 in 1937. Canadian asbestos, from the Thetford district of Quebec, continued to dominate world markets, the annual output being valued at upwards of $10,000,000. Canada is also an important exporter of gypsum, now being shipped to England and the United States, largely in the crude state. Increased uses have been found for anhydrite in manufacture of sulphuric acid, ammonium sulphate, and special plasters.

Ontario remains Canada's leading mineral province, although there was a 3 per cent decline in estimated value of all mine products to $221,425,000 in 1938. Gold produced advanced 10.5 per cent in quantity, and there was an increase of 10,000,000 lb. in blister copper to approximately 331,000,000 lb. for the year. Due to lower prices, platinum dropped below the record figure set in 1937. These three metals and nickel account for 90 per cent of Ontario's mining activity.

Eighteen new mills went into operation at gold mines in Ontario in 1938, bringing the total number of producers to 60. In 1939 there are expected to be about twenty more. The prosperity has been shared by all the established camps, particularly those of Beardmore-Little Long Lac, Porcupine, and Larder Lake. Important increases in ore reserves have been effected in the older mines as well as those more recently developed. The stable nickel-copper industry at Sudbury held closely to former high levels.

The Cobalt camp showed improvement, silver and cobalt being produced in small quantities from twenty or more of the old properties under lease, after long idleness. Salt, quartz, gypsum, graphite, talc, and nepheline syenite were produced in the province in important quantities in 1938, the syenite industry having been started two years ago with a daily output of 100 tons. A second mill, of 150 tons' capacity, is being built.

Quebec has shown a greater in-

Table I—Canadian Mines Planning Production in 1939

Mining Property	District	Proposed Mill Capacity
ONTARIO		
Addington Mines (Rich Rock) (a)	Hastings	200
Algoma Ore Properties (Helen Mine, siderite) (c)	Michipicoten	2,000
Berens River Mines	Patricia	225
Bilmac Gold Mines	Shining Tree	75
Chesterville Larder Lake Gold Mining Co.	Larder Lake	500
Cole Gold Mines	Red Lake	100
Darkwater Mines	Sturgeon Lake	25
De Santis Porcupine Mines	Porcupine	150
Devon Gold Mines	Matheson	50
Edwards Cons. Gold Mines	Goudreau	75
Elizabeth Gold Mining Co	Rainy Lake	25
Golden Summit Mines	Kirkland Lake	15
Goldwood Gold Mines (Horshoe)	Kenora	125
Jellicoe Cons. Gold Mines	Little Long Lac	25
Kay-Hays Mines	Schreiber	25
Kerry Gold Mines (Ardeen)	Thunder Bay	200
Kirkland Gold Rand	Kirkland Lake	300
Kenricia Gold Mines	Kenora	100
Lucky Kirkland Gold Mines	Kirkland Lake	35
Melba Gold Mines	Kirkland Lake	150
Preston East Dome	Porcupine	300
Ronda Gold Mines	Shining Tree	125
Sarmac Gold Mining Corp. (Dikdik)	Jellicoe	25
Schreiber Pyramid Gold Mines	Schreiber	50
Tionaga Gold Mines	Horwood Lake	50
Tyranite Mines (Sylvanite)	Matachewan	200
Uchi Gold Mines	Woman Lake	500
Upper Seine Gold Mines		75
Vimy Gold Mines	Hislop	50
Dennison Nickel Mines	Sudbury	250
QUEBEC		
Amm Gold Mines	Cadillac	125
Central Duverny Gold Mines	Duverny	50
Quebec Manitou Mines	Dubuisson	500
Tiblemont Island Mining Co	Tiblemont	50
BRITISH COLUMBIA		
Abco Mines (Premier Gold)	Vancouver Island	....
B. C. Nickel Mines (d)	Vancouver Island	50
Euphrates Gold Mines	Nelson	200
Central Zeballos Gold Mines	Zeballos	50
Gold Fern Mines (b)	Nelson	50
Havilah Gold Mines	Zeballos	75
Man-O-War Mines (Rimy)	Zeballos	50
Perrier Gold Mines	Nelson	50
Porcher Island Mines	Prince Rupert	75
Salmo-Malartic Mines (d)	Sheep Creek	50
Silver Standard Mines Co. (b)	New Hazelton	100
Utica Mines (b, d)	Slocan	50
NORTHWEST TERRITORIES		
Negus Mines	Gordon Lake	100
Box Mines (a)	Athabasca Lake	1,500
Flin Flon Gold Mines	Saskatchewan	100

(a) controlled by Cons. Mining & Smelting Co. of Canada; (b) former producer; (c) controlled by Algoma Steel Corp.; (d) Base metals.

Table II—Canadian Metal Mines Producing in 1938

Mining Company	Gold Recovery Per Ton	Working Costs Per Ton	Daily Tonnage	Mill Capacity	Date of First Production
ONTARIO					
Amherst Gold Mines (Algold)	3.76	.....	50	100	June, 1936
Algoma Summit Gold Mines	1.51	.....	123	250	Mar., 1936
Argosy Gold Mines (Casey) (*g*)	11.15	.....	88	120	July, 1934
Bankfield Cons. Gold Mines	13.72 (*ll*)	8.40	131	145	May, 1937
Bidgood Cons. Gold Mines	11.61 (*ll*)	8.67	146	160	July, 1934
Bousquet Gold Mines	11.25	.....	100	.....	1938
Buffalo Ankerite Gold Mines (#)	8.22	4.64 (*ll*)	940	1,000	June, 1926
Central Patricia Gold Mines	18.06	7.95	211	250	June, 1934
Clark Gold Mines (*g*)	.. ..	....	.....	35	April, 1938
Cline Lake Gold Mines (O'Brien)	.....	.....	....	200	Aug., 1938
Coniaurum Gold Mines (*j*)	8.75	7.25	464	600	May, 1928
Cordova Gold Mines (*r*)	.....	.....	.....	100	1938
Delnite Mines (Sylvanite)	6.41 (*rr*)	5.70	192	275	June, 1937
Dome Mines (*ll*)	12.13	4.48	1,527	1,600	1910
Elora Gold Mines (*g*)	2.11	.....	25	60	1936
Gillies Lake-Porcupine Mines	7.82	.....	51	100	May, 1935
Gold Eagle Gold Mines	8.24 (*hh*)	7.62	88	125	Oct., 1937
Golden Gate Mining Co	16.08	.....	50	150	May, 1938
Hallnor Gold Mines (Noranda)	.....	.....	.....	400	1938
Hard Rock Gold Mines	15.30	.....	.....	300	Jan., 1937
Hollinger Cons. Gold Mines	8.65	4.84	4,762	5,700	1910
Howey Gold Mines	2.42	1.38	1,226	1,500	April, 1930
J. M. Cons. Mines (Jackson-Manion)	10.71	.....	87	100	Aug., 1936
Kerr Addison Gold Mines	.....	.....	.....	600	May, 1938
Kirkland Lake Gold Mines	14.72	.....	235	250	1919
Lake Shore Mines (*ss*)	16.19	5.99	2,578	2,600	1918
Lebel Oro Gold Mines (*b*)	6.35	.....	64	110	April, 1937
Leitch Gold Mines	23.36 (*ll*)	13.41	84	100	Jan., 1937
Little Long Lac Gold Mines	16.68	7.83	216	300	Dec., 1934
Macassa Mines	16.16	6.62	252	450	Oct., 1933
Mace Gold Mines (Vipond)	4.31	4.23	290	300	1911
MacLeod-Cockshutt Gold Mines	.....	.....	.....	500	April, 1938
Madsen Red Lake Gold Mines	.....	.....	.....	360	July, 1938
Matachewan Cons. Mines (*j*)	5.34	4.48	368	400	Nov., 1934
McKenzie Red Lake Gold Mines	14.83	4.72	161	225	Mar., 1935
McIntyre Porcupine Mines	9 39	4 84	2,440	2,500	1912
Minto Gold Mines (Jubilee)	2.26	3.17	70	115	June, 1931
Moneta Porcupine Gold Mines	18.64 (*gg*)	6.85	.....	200	Jan., 1938
Morris Kirkland Gold Mines (*g*)	5.63	8.12	99	125	Oct., 1936
Naybob Gold Mines (Hayden)	2.21	.....	25	150	1935
NewGoldenRoseGoldMines (*ll*,*r*)	11.79 (*mm*)	12.99	112	125	July, 1937
Northern Empire Mines (Newmont)	14.77 (*ii*)	.....	166	200	Mar., 1934
Omega Gold Mines (Castle-Treth.)	4.67	3.88	464	525	1936
Pamour Porcupine Mines (*h*)	7.40	3.32	728	1,500	May, 1936
Parkhill Gold Mines (*g*)	7.93	.....	69	100	July, 1931
Paymaster Cons. Mines (*b*)	7.37 (*ll*)	.....	526	550	Oct., 1934
Pickle Crow Gold Mines	23.14	6.85	308	400	April, 1935
Porcupine Lake Gold Mines	.....	.....	.....	40	1938
Raven River Gold Mines	8.67 (*ll*)	.....	65	75	Nov., 1937
Red Lake Gold Shore Mines	9.48	7.16	132	150	Sept., 1936
Ross (Hollinger Cons.)	11.22	6.02	100	100	Jan., 1936
Sachigo River Exploration Co	.....	.....	.....	25	May, 1938
Sand River Gold Mining Co	12.79 (*ll*)	.....	95	100	Dec., 1937
St. Anthony Gold Mines	9.51	5.36	90	100	Aug., 1927
Straw Lake Beach Mines	.....	.....	.....	60	Dec., 1938
Sturgeon River Gold Mines	18.07 (*ll*)	8.00	68	75	April, 1937
Sylvanite Gold Mines	12.73	.....	450	520	July, 1927
Tashota Goldfields (*g*)	8.51 (*bb*)	.....	40	90	April, 1935
Teck-Hughes Gold Mines	10.62	.....	1,102	1,300	1917
Toburn Gold Mines (*i*)	21.18 (*yy*)	11.87	103	150	April, 1913
Tombill Gold Mines (Newmont)	15.91 (*gg*)	.....	.....	100	1938
Upper Canada Gold Mines (##)	18.00	.....	120	150	Nov., 1938
Wendigo Gold Mines	12.11 (*ll*)	8 04	90	100	Jan., 1936
Wright-Hargreaves Mines	18.15	7.35 (*uu*)	1,198	1,200	May, 1912
Young-Davidson Mines (*z*)	3.34	1.96	937	1,000	Sept., 1934
International Nickel Co. (*pp*)	.. ..	.....	16,334	18,000	1916
Falconbridge Nickel Mines (*j*)	.....	5.74 (*nn*)	1,213	1,250	Feb., 1930
M. J. O'Brien (Cobalt) (*t*)	.....	.....	(*l*)	250	
(Gowgando) (*t*)	.....	.....	(*l*)	80	
Chromium Mining & Smelting (*k*)	.....	.....	(*l*)	100	1935
Phoenix Molybdenite Corp. (*g*)	.. ..	.. ..	25 (*oo*)	50	Aug., 1937
NOVA SCOTIA					
Avon Gold Mines (Oldham) (*b*)	.. ..	.. ..	5	100	May, 1936
Caribou Gold Mines (*r*)	.....	.....	(*l*)	15	1934
Gold River Mining Synd	.....	.....	(*l*)	15	
Guysborough Mines (*j*)	8.92	6.97	70	100	1934
Lacey (Government project)	.....	.....	.....	35	1934
Horne Mines	.....	.....	.....	10	
Mineral Industries (Wine Harbor) (*b*)	.....	.....	25	75	May, 1937
Montague Gold Mines	5.33	5.38	60	200	1933
NovaScotia GoldMines (Tangier)	.....	.....	(*l*)	100	1936
Nugold Mining Corp. (Block-house Dome) (*b*)	.....	.....	25	35	Jan., 1937
Otter Lake Gold Synd	.....	.....	30	75	July, 1937
Queens Mines	.....	.....	25	50	1935
Seal Harbor Gold Mines	.....	.....	(*l*)	200	Aug., 1936
United Goldfields of N. S. (Brookfield) (*b*)	.....	.....	10	25	Feb., 1934
Waverley Cons. Gold Mines (Lake Thomas) (*b*)	.....	.....	50	75	1937
QUEBEC					
Aldermac Copper Corp. (*d*, *qq*)	.....	2.03	479	1,200	Jan., 1937
Arntfield Gold Mines	3.76 (*ll*)	3.09	272	400	Aug., 1935
Beattie Gold Mines (*j*, *x*)	5.02	3.69	1,530	1,800	May, 1935
Belleterre Mines (McYntyre)	7.77	.....	.....	100	Aug., 1936
Canadian Malartic Gold Mines (*j*)	4.51	2.57	636	700	May, 1935
CournorMiningCo. (Bussieres) (*b*)	5.46 (*kk*)	4.00	200	210	Sept., 1937
East Malartic Mines	.....	.....	.....	1,200	Nov., 1938
Francoeur Gold Mines	5.37	4.13	.....	150	June, 1938
Halliwell Gold Mines (*xx*)	15.13	5.55	.....	.....	1938
Jacola Gold Mines (Green-Stabell) (*g*)	.....	.....	70	100	Dec., 1933
Lake Rose Quebec Mines	.....	.....	.....	25	June, 1938
Lamaque Mining Co. (Teck-Hughes)	13.34	.....	250	1,000	April, 1935
Lapa Cadillac Gold Mines	.....	.....	185	250	July, 1938
Noranda Mines	5.95	3.50	5,250	6,000	Dec., 1937
Normetal Mining Corp. (*e*, *jj*, *vv*)	.....	.....	199	500	Sept., 1937
McWatters Gold Mines	12.30	11.34 (*mm*)	93	100	Sept., 1934
Molybdenite Corp. of Canada	.....	.....	.....	30	1938
O'Brien Gold Mines	40.95	9.65	150	150	Sept., 1934
Pan Canadian Gold Mines	.. ..	.....	.....	50	1938
Payore Gold Mines	.....	.....	.....	75	May, 1938
Perron Gold Mines (*yy*)	10.11	5.15	335	350	April, 1934
Powell Rouyn Gold Mines (*n*)	5.56 (*ll*)	.....	400	.....	1937
Shawkey Gold Mining Co	11.10	.....	135	170	Mar., 1936
Sigma Mines (Dome)	8.02	4.15 (*ll*)	.....	650	Mar., 1937
Siscoe Gold Mines	10.92	4.60 (*ll*)	557	600	Jan., 1929
Saladen-Malartic Mines	6.50 (*ll*)	3.70	277	650	Jan., 1938
Stadacona Rouyn Mines	5.67 (*yy*)	3.99	403	500	Nov., 1936
Sullivan Cons. Mines	13.86	8.12	152	300	May, 1936
Thompson Cadillac Mining Corp.	5.08	.....	70	215	June, 1936
Cons. Copper & Sulphur (Eustis) (*c*, *d*)	.. ..	.. ..	(*l*)	200	1865
Waite Amulet Mines (*h*, *vv*)	.. ..	.....	500	500	June, 1937
MANITOBA					
Beresford Lake Mines	.....	.....	.....	75	1937
God's Lake Gold Mines	11.43 (*yy*)	7.90	196	200	Sept., 1935
Gunnar Gold Mines	11.99 (*ll*)	7.22	143	150	April, 1936
Gurney Gold Mines (Wylie-Dominion)	8.75	.....	110	145	Oct., 1937
Laguna Gold Mines (Red) (*e*)	18.00 (*ll*)	.....	90	100	Aug., 1936
San Antonio Gold Mines	9.09	5.26	321	335	July, 1932
Hudson Bay Min & Sm. (Flin Flon) (*dd*, *mm*)	.....	5.89	4,576	4,600	Sept., 1930
Sherritt Gordon Mines (*b*, *f*, *ff*)	.....	.....	1,500	1,500	Aug., 1937
SASKATCHEWAN					
Athona Mines (*g*)	.....	.....	.....	15	1936
Flin Flon Gold Mines	.....	.....	.....	100	1938
Monarch Gold Miners Synd	.....	.....	.....	25	1938

crease in gold production than any of the other provinces, for the third consecutive year. The advance in 1938 over the preceding year was 17 per cent, with an output of about $30,000,000. Quebec added eight new producers in 1938, bringing the total to 29, including Molybdenite Corporation, Aldermac, Waite Amulet, and Normetal (in the northern district), and the old established Consolidated Copper & Sulphur mine, at Eustis, near the Vermont border. The province has five new producers in prospect for 1939.

Grade of ore was somewhat reduced at Siscoe Gold Mines, but, in the same district, Lamaque and Sigma achieved outstanding results from aggressive exploration. The Malartic and Cadillac camps expanded. Noranda announced a broad program of enlarged operations for the next few years. Waite Amulet, after diamond-drilling a major copper-gold-zinc orebody, discovered at 1,000 ft. depth, started building a new 1,000-ton mill.

Output of copper and silver in Quebec improved. The estimated value of all minerals produced in 1938 was $67,000,000, compared with $57,000,000 the previous year. Important nonmetallics of the province included asbestos, mica, feldspar, magnesite, talc, ochre, quartz, and building materials.

The value of mineral production in British Columbia was affected more severely than in any other province by weak markets for base metals, the estimated figure being $64,250,000, compared with $74,475,902 in 1937. Of this value, gold accounts for $20,619,714, or 16 per cent more than in 1937.

Prospecting in British Columbia was stimulated by discoveries of spectacular gold-bearing quartz veins on the northwest coast of Vancouver Island in the Zeballos district. The 54 mines producing precious metals include ten that started milling during the year, three of them at Zeballos. A similar number have announced plans for starting production in 1939.

Interesting discoveries were made last summer in the Yellowknife area of the Northwest Territories. The Con mine of Consolidated Mining & Smelting Company of Canada went into production with a 100-ton mill and the Negus mill, of similar size, is now being built in the adjoining Gordon Lake area. In both areas approximately 4,000 claims have been staked and a number of promising discoveries reported which are under development.

The Consolidated company also controls the Box mine, at Goldfields, Athabasca Lake, in northern Saskatch-

Table II—Canadian Metal Mines Producing in 1938 (Continued)

Mining Company	Gold Recovery Per Ton	Working Costs Per Ton	Daily Tonnage	Mill Capacity	Date of First Production
BRITISH COLUMBIA					
Ainsworth Mines (*t*)	.....	.....	.....	.....	Jan., 1937
Ashloo Gold Mining Synd.	.....	.....	.....	25	July, 1936
Aztec Mines Co. (B.R.X. Gold)	.....	.....	.....	150	May, 1938
Bayonne Cons. Mines (Grull-Wihksne)	21.68	13.75 (*zz*)	54	60	Nov., 1936
Bealemore Milling Co. (Wayside)	.....	.....	.....	150	Nov., 1934
Bralorne Mines (*q*)	16.95	6.09	474	550	Feb., 1932
Cariboo Gold Quartz Mining Co.	14.69	7.59	196	300	Jan., 1933
Cariboo-Hudson Gold Mines	.....	.....	50	100	Nov., 1938
Cons. Nicola Goldfields (Jenny Long) (*b*)	.....	.....	.....	100	1935
Dictator Gold Mines	.....	.....	.....	35	1938
Dentonia Mines (Durango) (*u*)	.. ..	.....	.....	100	Jan., 1938
Dunwell Mines (Welldun M. & M.) (*g*)	.....	.....	.....	40	May, 1934
Esperanza Mines	.....	.....	.....	35	1937
Fairview Amalg. Gold Mines	4.23	3.61 (*tt*)	100	200	1936
Forshaw (Brooklyn)	.....	.....	.....	50	1938
Gem Gold Mines	.....	.....	.....	50	1938
Gold Belt Mining Co.	19.03	4.50	147	150	Oct., 1938
Gold Mountain Mines (Hedley) (*g*)	5.43	.....	(*l*)	50	Dec., 1936
Grange Cons. Mines (Pavilion Mt.) (*g*)	.....	.....	.....	50	Oct., 1934
Greenbridge Gold Mines	.....	.....	.....	100	1938
Hedley Mascot Gold Mines (*a, t*)	15.75	.....	175	200	May, 1936
Highland-Bell (*t*)	(*hh*)	.....	.....	.....	1930
Island Mountain Mines (Newmont)	14.27 (*ll*)	8.91	124	150	Nov., 1934
Kamloops Homestake Mines (*u, g*)	14.03	.....	(*l*)	50	1936
Kelowna Exploration Co. (Nickel Plate) (*s*)	..... (*s*)	.....	200	225	1934
Kootenay Belle Gold Mines (*u, b*)	13.96 (*ll*)	.....	134	150	Dec., 1934
Livingstone Mining Co.	.....	.....	.....	30	1937
McArthur (Granby) (*b*)	.....	.....	.....	50	1938
McCarthy (Union) (*b*)	.....	.....	.....	200	1933
Minto Gold Mines	.....	.....	.....	125	Dec., 1934
New True Fissure Min. & Mill. (*u*)	.....	.....	.....	100	Oct., 1937
Osoyoos Mines	16.45	.....	(*l*)	125	Oct., 1935
Pioneer Gold Mines of B. C.	14.49	6.98	350	400	1928
Polaris-Taku Mining Co.	12.00	.....	.. ..	200	1938
Privateer Mines	43 33 (*ii*)	.. ..	.. ..	75	Sept., 1938
Quesnell Quartz Mining Co.	.. ..	.. ..	.. ..	25	Nov., 1938
Relief Arlington Mines (*i*)	14 34	.. ..	81	90	1933
Reno Gold Mines	19.92	10.46	120	140	Aug., 1929
Reward Mining Co. (Surf Point) (*b*)	12.34	.....	(*l*)	25	Feb., 1937
Rey Oro Gold Mines	140.00	.....	.....	5	1938
Sheep Creek Gold Mines (Queens)	16.84 (*ll*)	5.76	148	150	May, 1935
Silbak Premier Mines (*i, m*)	9.55 (*kk*)	.....	481	550	1919
Skidegate Gold Mines (*g*)	.....	.. ..	.....	70	1937
Spider Gold & Silver Mines	.....	.. ..	.....	50	1938
Spud Valley Gold Mines	30.00	.....	.....	50	Nov., 1938
Surf Inlet Cons. Gold Mines	15.89	.....	30	100	April, 1936
Vancouver Island Gold Mines	.....	.....	.....	25	1938
Velvet Gold-Copper Mines (*a*)	.....	.....	.....	100	1932
Vidette Gold Mines (*a*)	.....	.....	70	80	Dec., 1935
Wesko Mines (Central Start) (*a*)	7.89	6.02	90	100	Nov., 1936
Western Exploration Co.	.....	.....	.....	150	1938
Wilcox Mining Synd. (*u*)	16.50	.....	12	20	1934
Windpass Gold Mining Co.	.....	.....	40	50	Jan., 1934
Ymir Cons. Gold Mines (Goodenough) (*u*)	.....	.....	50	100	July, 1935
Ymir Yankee Girl Gold Mines (*u, uu*)	9.79	8.22	125	140	July, 1934
Cons. Mining & Smelting Co. (Kimberley) (*p*)	.....	.. ..	.. ..	6,600	1906
Cons. Mining & Smelting Co. (Tadanac) (*a, y*)	.. ..	.. ..	.. ..	2,400	1906
Britannia Mining & Smelting Co. (*a, p, w*)	.. ..	.. ..	.....	6,000	1903
Base Metals Mining Corp. (*b, p, e*)	.....	.....	.....	300	Nov., 1937
Granby Cons. Min. & Sm. (Allenby) (*a, b, oo*)	.....	.....	.....	3,000	June, 1937
Noble Five Mines (Slocan) (*b, u*)	.....	.....	.....	100	Aug., 1935
Buena Vista Mining Co. (Big Missouri) (*r, ii*)	.....	.....	630	800	April, 1938
NORTHWEST TERRITORIES					
Bear Exploration & Radium (*t, **)	.....	.....	.....	35	Oct., 1935
Con Mine (*r*)	.....	.....	.....	100	1938
Eldorado Gold Mines (Pitchblende-silver) (*o*)	.....	.....	70	150	1933

(*a*) Copper-gold producer. (*b*) Former producer. (*c*) Continuous operation since 1879. (*d*) Shipping copper and sulphur concentrates. (*e*) Controlled by Mining Corp. of Canada. (*f*) Copper-gold-silver producer. (*g*) Production temporarily suspended. (*h*) Controlled by Noranda Mines. (*i*) Controlled by Premier Gold Mining Co., one of the 10 principal foreign development companies of American Smelting & Refining Co. (*j*) Controlled by Ventures Ltd.; 45% in Beattie Gold. (*k*) In 1936 smelter at Sault Ste. Marie produced ferrosilicon and ferrochrome valued at $177,207. (*l*) Not reported. (*m*) Controlling 5 mines in Portland Canal area, including the Premier, largest Canadian silver producer. (*n*) Shipping to Noranda smelter. (*o*) Approximate monthly output, silver 80,000 oz.; radium 3 grams; in 1935, 296 tons concentrates; in 1936, 401.5 tons; in 1937, 668.6 tons. Value of radium, silver, and uranium produced in 1937, $850,000. (*p*) Silver-lead-zinc producer. (*q*) Also treating ore from Bradian mine. (*r*) Controlled by Cons. Mining & Smelting Co. of Canada. (*s*) Formerly largest B. C. gold producer. (*t*) Silver producer. (*u*) Gold-silver-lead-zinc producer. (*v*) First four months 1937. (*w*) Controlled by Howe Sound Co. (*x*) Controlled by Nipissing mines. (*y*) At Trail, B. C., are located customs concentrator, zinc production plant, and refinery, copper smelter and refinery, lead smelter and refinery, fertilizer plant, etc. (*z*) Subsidiary of Hollinger Cons. Gold Mines. (*#*) Combined with Marbuan, formerly March Gold Mines. (*aa*) Mining costs per ton, 1936. (*bb*) Excluding 182,514 lb. copper in concentrates shipped, 1937. (*cc*) Mill operated Aug.-Nov. 1937. (*dd*) Ore milled in 1937 averaged 2.17% Cu, 4.7% Zn, 0.107 oz. Au, 1.52 oz. Ag. Smelter byproducts were cadmium, selenium, tellurium. (*ee*) Before taxes, depreciation, depletion. (*ff*) Net costs of electrolytic copper in 1937, 7.097c per lb.; net loss on 5-months period, $80,549, after depreciation and deferred development; concentrates shipped to Flin Flon. (*gg*) First quarter, 1938. (*hh*) First half, 1938. (*jj*) Copper concentrates treated at Noranda, zinc concentrates in England. (*ii*) Figures for Oct.-Nov. 1938. (*kk*) Figures for Nov., 1938. (*ll*) For first 11 months, 1938. (*mm*) Including depreciation. (*nn*) Gross operating profit. (*oo*) Costs in 1937 were 9.41c per lb. of copper on 10,451,364 lb. (*pp*) Production in 1937 came from Frood, Creighton, Levack, and Garson mines; total metal sales were: nickel, 207,700,943 lb.; copper, 291,880,403 lb.; silver, 2,356,170 oz.; gold, 75,849 oz.; platinum, 188,756 oz.; selenium, 81,334 lb.; tellurium, 4,423 lb. (*qq*) Average ore grade in 1937: 1.97% Cu, .011 oz. Au, 0.435 oz. Ag and 50% sulphur concentrates; a 50-ton plant for recovering elemental sulphur now being built; operating costs shows for first 21 days of March, 1938. (*rr*) For first 10 months' operation. (*ss*) For fiscal year ended June 30, 1938. (*tt*) For June, 1938. (*uu*) For fiscal year ended Aug. 31, 1938. (*vv*) Copper-zinc-gold producer. (*ww*) For first 9 months, 1938. (*xx*) Shut down in Sept. after shipping 2,718 tons to Arntfield mill. (*yy*) For first 10 months, 1938. (*zz*) For fiscal year ended Oct. 31, 1938. (*##*) Using Morris Kirkland mill. (***) Av. monthly output in 1938, 50,000 oz. Ag, 11% uranium in concentrates.

ewan, where an orebody has been developed for a length of 2,000 ft. and an average width of 200 ft. This is expected to have an initial production of 1,500 tons in 1939, which is to be increased to 5,000 tons subsequently. A second mine in the same province, near Flin Flon, is to start production at 100 tons daily this year.

Manitoba registered a 14 per cent increase in the value of metal production in the first half of 1938, attributable largely to Hudson Bay and the six gold mines of the province. No new mills went into operation in 1938 and none are planned for 1939. At Flin Flon, a general increase in the scale of production is evident.

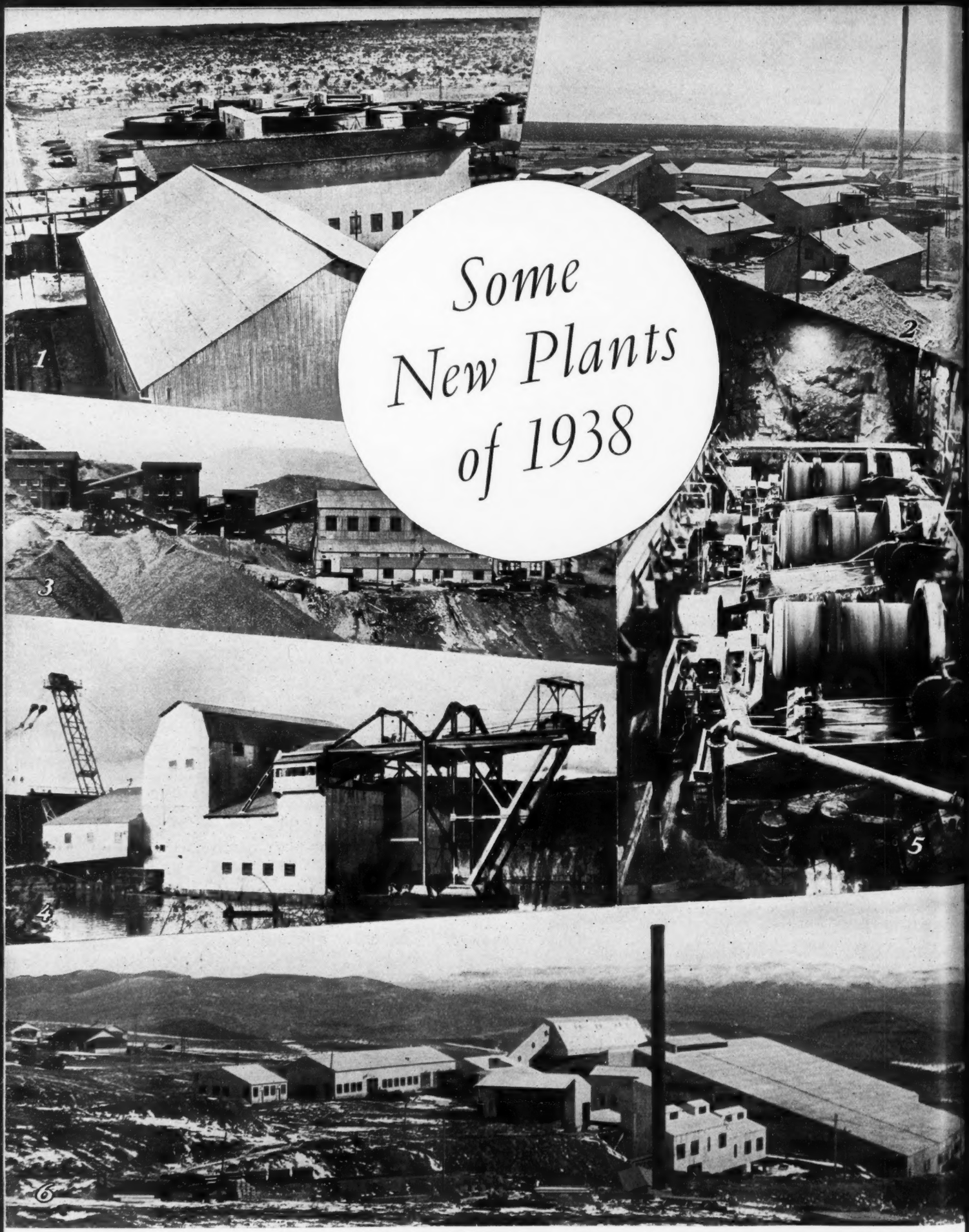
In Nova Scotia, in addition to the fifteen gold mines operating mills in 1938, six were undergoing development. For the first half of the year gold production was valued at $446,292, with a total of around 25,000 oz. estimated for the full year.

The dividend record of the mining industry was excellent, in view of adverse market conditions for base metals. Fifty-eight mining companies, not including Bulolo, Lava Cap, and other foreign operations that have been largely financed through Toronto and Montreal, paid a total of $95,128,380 to shareholders in 1938. In the preceding year 51 companies paid $104,637,100 and in 1937 the total disbursed amounted to $81,112,968.

Table IV—Cumulative Dividend Record of Canadian Metal Mines (a)

Province and District	1934	1935	1936	1937	1938	Total to End of 1938
ONTARIO:						
Sudbury	$10,125,156	$13,866,659	$21,886,752	$35,736,054	$32,103,201	$261,808,177
Cobalt (*c*)	245,790	150,000	600,000	444,000	180,000	107,062,442
Porcupine	11,910,041	9,952,883	11,021,672	12,169,765	12,675,188	157,796,202
Kirkland Lake	13,930,381	14,584,641	16,989,780	20,259,948	16,299,277	137,315,304
Patricia	500,000	420,000	1,652,900	2,714,950	3,095,661	8,394,011
BRITISH COLUMBIA	$6,762,820	$11,147,258	$16,752,748	$17,550,778	$13,890,001	$192,357,306
QUEBEC	5,225,505	5,544,898	8,114,999	8,951,527	11,287,335	52,938,713
MANITOBA	112,023	3,228,734	3,082,517	5,230,586	4,773,541	16,427,400
NOVA SCOTIA (*b*)	.....	.....	.....	.....	.....	47,928
MISCELLANEOUS	529,138	568,818	1,011,560	1,579,552	1,176,893	4,768,960
Totals	$49,470,854	$59,364,889	$81,112,948	$104,637,160	$95,481,097	$939,016,448

(*a*) Data compiled by Northern Miner. (*b*) Paid in 1900; dividend record incomplete. (*c*) Since 1933, paid by Nipissing Mines, a holding company.



1. The modern cyanide plant of Big Bell Mines, at Cue, Western Australia. Its capacity is 6,300 tons per month.

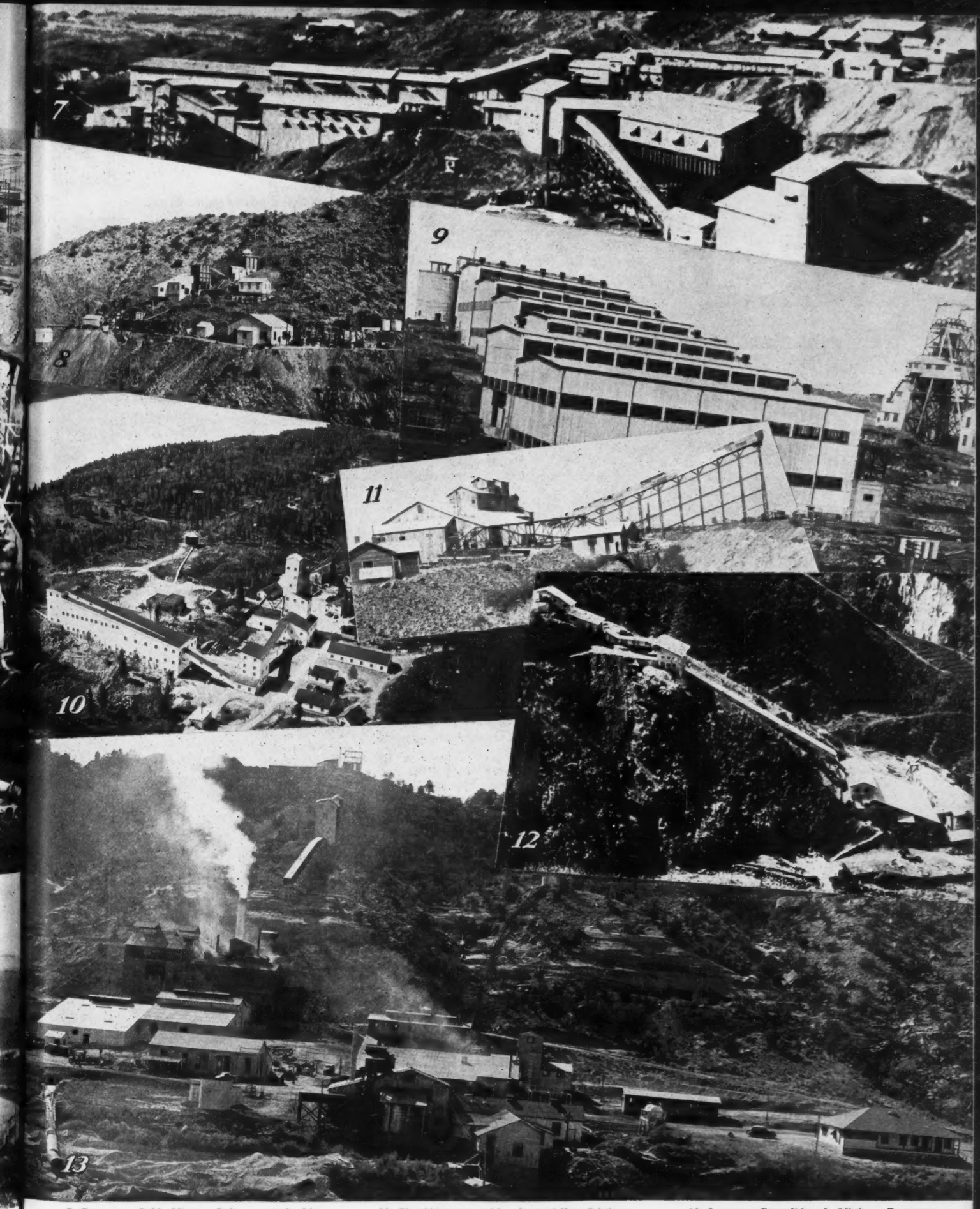
2. Gold Mines of Kalgoorlie, Western Australia, built this roasting-cyanidation plant for sulpho-telluride ores.

3. The new 2,000-ton crushing and screening unit (seen at left) was added by Anglo-American Mining Corporation to the 500-ton Yellow Aster mill, Randsburg, Calif.

4. Australia's largest bucket dredge, that of Wellington Alluvials, Ltd., Wellington, N.S.W. It has 14-cu.ft. buckets, and treats more than 250,000 cu.yd. per month.

5. In the underground flotation and cyanide plant in the Big Missouri mine, 21 miles from Stewart, B. C. For fine grinding it has three 6x12-ft. ball mills and rake classifiers, here seen

6. The 600-ton cyanide plant at the Getchell mine, near Golconda, Nev., handles daily 500 tons of oxide ore and 150 tons of sulphides. The latter are roasted before cyanidation



7. Emperor Gold Mines, Ltd., erected this cyanide plant of 12,000 tons' monthly capacity at Tavua, Fiji Islands

8. The 100-ton flotation plant of Comstock-Dexter Mines, Prescott, Ariz.

9. North Broken Hill, Ltd.'s concentrator, Broken Hill, N.S.W., of 600,000 tons' annual capacity, employs jigs, tables, and flotation

10. The 500-ton cyanide plant of Kerr-Addison Gold Mines, Ltd., at Larder Lake, Ont. Merrill-Crowe precipitation is used

11. A Tri-State plant—the Martin tailings retreatment mill of the Semple Mining Company, Hockerville, Okla. Capacity 100 tons hourly. All tailings treated are transported to the plant by trucks

12. Lepanto Consolidated Mining Company, north of Baguio, P. I., began milling copper ore in this plant and shipping 1500 tons of concentrates monthly to Japan

13. United States Vanadium Corporation's new plant at Uravan, Colo. From the hill-top down are seen the ore bins, crushing plant, fine bins, roasters, and leaching plant

Mexico

Expropriation of oil companies sets a precedent. Mining industry's difficulties with labor increase. Taxation heavier. Cooperative movement grows

A. H. Hubbell

Associate Editor

THOSE INTERESTED in the mining industry in Mexico who had long been apprehensive over the course of events in that country, feeling that the attitude of Labor there was a challenge to ownership and management, found these fears justified when early in 1938, on March 18, the Executive expropriated the properties of a group of American and British petroleum companies, which at the time was producing a very large part of the oil output of the country. The act suggested that a scheme had been concocted to this end, coming as it did as the culmination of a one-sided struggle between the oil companies and the Petroleum Workers' Union, which on Nov. 3, 1936, had asked for a single collective contract for the group embodying demands so fantastic as to invite opposition, thereby providing, as it turned out, a pretext for expropriation. Despite official protests from Washington and London, the properties remained in Mexican hands at the year's end, with the future seemingly dependent on whatever attitude Washington, concerned with its Pan-American program, might choose to take.

Thus the possibility of nationalization of the country's natural resources which had been lurking in the background for several years became an actuality in 1938, at least in part. Questions hitherto puzzling received their answer. The real objective of Labor's tactics, long thinly disguised as merely an effort to improve the condition of the working man, was at last unmasked.

All in all, the net effect of the seizure of the oil properties is unfortunate for the metal mining industry, setting, as it does, a precedent that may be followed at some future time whenever difficulties between operators and employees become acute and the Government thinks the moment favorable. It can hardly be said to have eased the difficult labor situation for the mining companies.

However, any ardor for further immediate attempts along this line, if it existed, must have been quickly tempered by contemplation of the results. These included the loss of revenue to the already embarrassed Government and of income to the petroleum workers, inasmuch as the lack of markets and of transport means made it imperative to curtail or cease production. Further purchase of Mexican silver from the Government by Washington was stopped within ten days, whether by coincidence or design, thereby depriving the Mexican Government of the handling of the large amount of exchange resulting from the sales, as well as of the ¼ cent-per-ounce fee it had previously retained when settling with the silver producers. The peso fell. At the same time, the question of payment for the expropriated properties loomed —a question of concern for a country already in default on its obligations. Thus it was not difficult to surmise that any similar move against other industrial groups, such as the mines, if contemplated, would be deferred, despite national ambitions and aspirations of the Labor leaders. Nevertheless, one must not here ignore the steady increase in numbers of the so-called cooperative societies under Government fostering, a movement that may yet prove to be another means of accomplishing expropriation. Of this, more hereafter.

Aside from being thus forced to view an instance of wholesale expropriation, as something they had been fortunate in escaping, the mining companies conducted operations throughout 1938 much as in other recent years, though affected by certain secondary results of the seizure of the oil properties. Metal production was satisfactory in the main. Labor difficulties took a somewhat more unpleasant turn, if this were possible, and wage scales continued mounting. The peso remained firm until the expropriation of the oil properties, but thereafter declined severely, with great uncertainty prevailing at first as to its proper level. Taxation continued heavy, with a new export tax imposed in consequence of the decline of the peso with the purpose of capturing profits that might otherwise be gleaned from this circumstance. Linked with the subject of exchange, moreover, was the change effected in the procedure for disposing of the country's silver output, after the United States Treasury decided to make its further purchases on the open market instead of through the Bank of Mexico. And, finally, there was the continued growth of the cooperative movement.

The respective outputs of lead and silver remained substantial as in recent years, giving little reason for dissatisfaction. Smaller tonnages of zinc and copper were realized than might otherwise have been produced, thanks to labor disturbances at vital points. Production figures here presented are obtained from various sources.

The output of refined lead totaled 236,000 short tons in 1938, compared with 254,810 in 1937. Refined silver production is estimated at 86,000,000 fine ounces against approximately 85,000,000 the year before. The production of gold is placed at 894,000 fine ounces for the first 11 months of 1938, October and November being estimated, compared with 846,000 in twelve months of 1937.

Production of zinc in 1938 was approximately 39,000 short tons, compared with 40,364 in 1937. Blister copper output is estimated at 40,000 short tons for the year, against 51,538 in 1937.

Labor Difficulties

The comparative figures presented for the major metals indicate that the mining industry in Mexico continued to carry on despite its troubles. No lightening of this burden, however, can be reported. Strikes of employees remained numerous, the now-familiar technique of the Government-backed syndicates being prosecuted without change. The year saw periods of suspension of operations in various important centers, including Cananea, Pachuca, and Monterrey, and in the coal-mining and zinc-smelting area of Coahuila. Although these disputes were not quickly settled (one was still in progress at the end of the year) by easy capitulation to the demands, which as usual were fantastic, substantial concessions were nevertheless made in granting wage increases and various advantages.

The manner in which wages have mounted in the three years 1935 to 1937 inclusive is shown by the fol-

lowing figures: In 1935 wages and salaries (including indemnities) paid to workmen by the companies representing 100 per cent of the country's lead and zinc output, 84 per cent of the silver output, and 75 per cent of the gold and copper production, averaged 1,350 pesos per man. In 1936, the corresponding figure was 1,786 pesos and in 1937 2,116.68 pesos. The number of men involved was 38,359; 39,205, and 40,598 in the three years respectively. These figures do not include the expenditures made by the companies for medical service, hospitals, schools, and other contributions to welfare. Corresponding figures for 1938 are not available but were higher. In one important district the average daily wage paid by privately owned companies in 1938 averaged 6.25 pesos. If rest days, vacations and holidays for which the workman was paid be excluded in calculating, the corresponding average wage per shift actually worked was 7.70 pesos. In contrast to the private companies the Government-backed cooperative societies pay lower wages to their workers, who, moreover, do not receive many benefits they enjoyed when previously working for privately owned companies. Here one must remember that it is not possible to determine the purchasing power of wages in Mexico merely by converting pesos into dollars.

A further interesting comparison may be made between the average minimum wages actually paid by mining companies in several districts and the minimum wages prescribed by law in those districts. See the table.

The burden imposed on management by these labor disputes is truly heavy, by reason both of time consumed and of sheer worry. As has often been pointed out before, a settlement gives no assurance that the two-year collective contract, supposedly signed in good faith by both sides, will not be torn up whenever Labor chooses, alleging that economic conditions have changed sufficiently to upset the condition of equilibrium reached between the contracting parties. In any case, a company must expect to revise its contract every two years, and on such occasions it appears to be taken for granted that Labor will receive new wage increases and benefits, no matter what the condition in which the company finds itself. Thus as time goes on, such revisions entail greater and greater burdens.

The number of strikes is not a satisfactory index of the extent of labor trouble in Mexico in 1938, according to individuals conversant with conditions. These hold that the year was troublesome rather on account of the number of employees and character of issues involved in the strikes. According to them, the disputes have not revolved around questions of wages alone. Rather, Labor has made a very definite move in the direction of taking over administration and direction of operations, seeking to limit so far as possible the number of executive positions that the companies are permitted to fill with men who are not members of the unions. The miners' syndicate, moreover, it is said, has avowedly set out to do away with contract, or piece, work, even though the men so employed receive a minimum wage equal to that paid common labor irrespective of the work performed.

A source of greater worry, however, lies in the tendency to supplant the mine owners by their laborers. This substitution is comparatively easy and has taken place in several instances. The so-called "mining cooperatives" are the fruit of this tendency. Excessive demands on the part of the laborers lead to difficulties in drawing up the collective contract and then to a strike. Mining companies are practically defenseless against a protracted strike. At such a time, besides the great burden of maintaining those operations which cannot be discontinued without endangering the very life of a mining enterprise, a company is obliged to accept the intervention of the Labor Department to conciliate its differences with the workmen and, whenever conciliation is impossible, to submit to what is referred to as an "economic judgment" whereby the Labor Board determines whether the company is or is not in a position to accede to the laborers' demands. The determination of this economic judgment entails an investigation of the books of the company, its management, and in general of the way it handles its business. From the results of the investigation the Labor Board renders a decision.

One can readily perceive the dangers involved in such investigation. The experts appointed on the part of the laborers to conduct the investigation may think that the equipment of the property is insufficient, that the treatment of the ores is wasteful, that certain expenses are not justified, that salaries paid the management are too high, that amortization charges are not warranted, that money spent on exploration or preparation is wasted, that there are too many technicians on the pay rolls, and so on. Such a kind of "economic judgment" led to the expropriation of the oil companies' properties; the experts appointed by the Labor Board to conduct the investigation made glaring errors, but their decision and their recommendations prevailed. In the case of the oil companies the Government itself made the expropriation. In the case of the mining companies there has not been a direct act of expropriation by the Government, but there is a strong, constant pressure against them, including the enactment of legislation creating conditions that are favorable for the supplanting of the mine owners by their laborers, as the recent approved bill creating tax exemption for the cooperatives.

Still another difficulty has been that of securing an adequate day's work from workmen even where no labor troubles are supposed to exist. After settlement of one serious strike during the year, layoffs were practiced so extensively by the men that the President was asked to exert his influence to stop it.

Expropriation of the oil properties had other effects upon the mining industry than merely that of convincing it that its fears had been well founded. It served to weaken still further an already-weak exchange situation resulting from a shrinkage in the metallic reserves behind the peso that had come about as follows: The fall in prices in the United States had increased the volume of imports into Mexico and affected the prices of Mexican goods abroad. The metal reserve dwindled further as some, foreseeing that oil shipments might cease, began converting pesos into dollars. The movement grew as uncertainty spread and on the day of expropriation the Bank of Mexico ceased selling foreign currencies to protect the reserve, and the peso was cut loose from the dollar to find its own level, based on offer and demand.

Contributing further to the weakness of this situation, the United States Treasury in the closing days of March announced its decision to cease its

Minimum Wages Paid in Certain Districts

District	Legal Minimum Wage Industrial	Legal Minimum Wage Agricultural	Actual Minimum Paid by Mining Companies
Chihuahua	$2.50	$1.50	$3.55
Parral	2.50	1.50	3.60
Coahuila coal district	2.20	1.80	4.10
Real del Monte	2.25	1.50	4.00 *a* 4.60 *b*
Pachuca	2.25	1.50	4.00 *a* 4.60 *b*
San Luis Potosi	1.50	1.20	2.70
Matehuala	1.40	1.00	2.00
Cananea [1]	3.25	2.75 Basic wage	5.00 *a* 5.50 *b*
		March–Oct., 1938	5.20 *a* 5.70 *b*
		Nov.–Dec., 1938	5.50 *a* 6.00 *b*

a Surface. *b* Underground.

[1] Wages paid in Cananea vary on account of a differential paid the workmen above the basic salary, having regard to the price of copper.

silver purchases from the Mexican Government. It moreover cut its official price one cent to 44¢. per ounce on March 28 and to 43¢. on the following day, which price has since ruled. Thus was terminated the arrangement whereby the producers of Mexican silver had been able to sell their silver to the Bank of Mexico at ¼¢. per ounce below the United States Treasury price of 45¢. per ounce, receiving in payment either pesos or dollars as preferred. This silver was subsequently resold to the Federal Reserve Bank in New York at the Treasury price, completing the transaction. Under this arrangement some producers had also been privileged to offer in any month their output for that month and for the month following. The advantage of this procedure to the Mexican Government lay in the fact that, aside from deriving a profit of ¼¢. per ounce on each transaction, it had the handling of the resulting large amount of dollar exchange, in the neighborhood of $2,000,000 per month where transactions totaled no more than 5,000,000 oz. monthly, and often the total was much larger—a great advantage indeed in any effort to stabilize the peso.

Since the United States Treasury stopped buying silver direct from Mexico the procedure has been as follows: The Mexican producers themselves ship their silver to New York, have it re-cast here into American bars and sell it to the United States Government for delivery the following day, in accordance with the Treasury's regulations. On such shipments out of Mexico an invoice tax of 0.88 per cent is payable by the shipper, equivalent to approximately 35 points on the Treasury's price of 43¢. per ounce, established in March last year as already stated. When selling silver to the Bank of Mexico under the old arrangement the producer escaped this tax[1] but lost ¼¢. per ounce of the sale price as stated.

The reason for this change of procedure by the Treasury has never been divulged. Coming as it did on the heels of the oil expropriation it suggested a punitive measure. In any case it contributed to the continued weakness of the peso subsequently.

In the absence of offsetting factors a decline in the exchange value of the peso from 3.6 to approximately 5 to the dollar would be of proportionate benefit to all industries, such as mining, that sold their product abroad, while paying the bulk of their costs in pesos. Faced with the need of raising new funds through taxation, the Government seized upon this fact as excuse for a law, signed Aug. 5, imposing a 12 per cent tax on exports, to be collected on the appraised value of goods exported where the price in Mexican currency is higher than the average that prevailed in February, 1938. Appraised values for major metals were set by a Commission, named for the purpose, approximately as follows for the period from Aug. 10 "until amended" (expressed in United States currency equivalents):

Gold, per ounce troy, $30.90; silver, per ounce troy, $0.2140; copper, per pound, $0.0240; lead, per pound, $0.0098; zinc, per pound, $0.0059, and antimony, per pound, $0.0495.

[1] Sales to banking and credit institutions in Mexico are not subject to the invoice tax and the institution can resell without paying it.

On Nov. 20, the appraised values were amended as follows:

Gold, unchanged, $30.90; silver, unchanged, $0.2140; copper, $0.0294; lead, $0.0110; and zinc, $0.0065.

The appraised values are such that the export tax amounts to 9.1 per cent of the market price of gold and 5.7 per cent of 43¢. silver price (less the invoice tax).

As to whether the new law functions as intended, comment has it that the effects of the drop in exchange from 3.6 to approximately 5 may vary for each company. In one case, for example, the export tax, combined with the increase in the silver production tax, approximately cancelled the gain from exchange. Comment from another source has it that the Government is getting more than the exchange differential through the application of a sliding-scale basis of values in levying production taxes. In such case the 12 per cent export tax becomes an added burden. Further, the peso price of many supplies manufactured in Mexico has risen as exchange has fallen. And if labor costs advance, the net result is that much worse. Conversely, if the peso should strengthen (that is, drop below 4.95) the effect will be bad because the respective costs of Mexican labor and supplies are not likely to go down. There will be a gradual reduction in the silver production tax, but the new export tax law is predicated on exchange above 3.60.

Save as already noted, tax legislation remained unchanged. Some idea of the total tax burden may be gleaned from the following: The expenses of one operator for six months in 1938, divided into three categories, were approximately 34 per cent for

(*Continued on page* 66)

The map of Mexico below shows the more important mining and metallurgical centers of the country, from which collectively has been coming the bulk of metal production.

The Philippines

Output of gold gains 25 per cent. The outlook bright. New tax legislation is postponed. Base-metal industry grows during year despite marketing difficulties

Ralph Keeler

Manila, P. I.

AGAIN of more than 25 per cent in gold output over that of 1937, and an increase of some 29 per cent in cash dividends, sums up the result of the 1938 operations of the Philippine mining industry. Final gold production figures from 26 lode and three placer operations will show a total of around 64,000,000 pesos, compared to 51,200,000 pesos in 1937. Dividends will total close to 22,000,000 pesos, the 1937 figure being 17,200,000. Monthly tonnage of ore milled in the last quarter of 1938 was around 330,000, compared with the average of 260,000 tons in the last three months. The four placer operations now are handling nearly 375,000 cu.yd. of gravel a month, whereas at the end of 1937 the yardage was negligible. The Philippine peso is worth 50c. in United States currency.

Continuance of the Sino-Japanese hostilities has interfered seriously with the growth of the base-metal industry. The principal (and virtually the only) market for Philippine iron, copper, and manganese ores is Japan, and it has been increasingly difficult to release funds for the purchase of ores.

Future prospects continue bright, and there is every reason to expect that the 1939 gold output will pass the 70,000,000 peso mark. Several new milling plants are nearing completion, and a few of the larger companies are still working on expansion programs which will add to their production. In general, however, it may be said that the concentrated development and building programs launched in 1936 and 1937 by the leading organizations are practically completed, and that the companies are now just beginning to profit from the money and time spent.

Vigorous objection on the part of the mining industry, through its Chamber of Mines, to increased taxation has resulted in a postponement of all tax legislation pending a careful study of the situation by a commission appointed by President Quezon in July. The commission is expected to draw up a long-range tax program covering Government needs, so far as they can be estimated, for ten years.

Announcement in November that the Government would not appeal the decision of the Supreme Court of the Philippines on the Gold Creek case has done much to relieve the anxiety of the mining operators concerning possible legal difficulties with the Government. The case in question was a test suit filed to determine whether or not the locators of claims filed prior to Nov. 15, 1935, were entitled to patents of such claims, after compliance with the usual requirements. The Supreme Court decided in September, 1938, that such locators were entitled to patents.

The Government has started the development of the iron deposits of Surigao, in Mindanao, where some 500,000,000 tons of ore is indicated, 275,000,000 tons within easy access to the sea. Dr. H. Foster Bain, adviser to the Government on mining, and Quirico Abadilla, director of the Bureau of Mines, recently went to Japan to arrange for a market for this ore.

(*Continued on page 66*)

Philippine Gold Production

(Leading Producers Only)

	1938 (Estimated) Pesos	1937 Pesos
Antamok Goldfields	4,560,000	5,230,904
Baguio Gold	1,725,000	1,247,411
Balatoc	12,750,000	13,014,510
Benguet Cons	11,225,000	9,886,190
Benguet Explor	260,000	265,725
Big Wedge	1,940,000	1,388,978
Cal Horr	1,235,000	1,267,588
Coco Grove	2,210,000	.....
Cons. Mines (Tumbaga)	354,000	.....
Demonstration	1,800,000	1,664,008
East Mindanao	600,000	691,852
Gold Creek	131,236	262,947
Ipo Gold	986,000	627,739
Itogon	4,175,000	3,359,330
I. X. L.	3,110,000	2,220,566
Mapaso Gold	50,000	.....
Masbate Consolidated	4,231,000	2,966,127
Masbate Goldfields	56,359	.....
Mindanao Mining	125,000	.....
Mindanao Mother Lode	1,500,000	340,739
Nabago Gold & Silver	23,000	.....
North Mindanao	160,000	.....
Paracale Gumaus	385,000	.....
Royal Paracale	235,000	325,521
San Mauricio	4,025,000	1,879,164
Santa Rosa	900,000	.....
Surigao Consolidated	600,000	.....
Suyoc	1,695,000	1,445,477
Tambis Gold	242,000	149,497
Tinago	45,034	.....
Twin Tivers	420,000	130,952
United Paracale	2,595,000	1,902,050
Ambassador	78,039	68,125
	64,426,668	50,335,400

Dividends Paid by Philippine Mining Companies

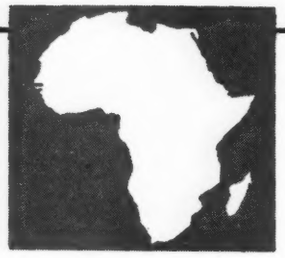
	1937 Per Share, Pesos	1937 Total, Pesos	1938 Per Share, Pesos	1938 Total, Pesos
Acoje	.....	.....	0.01	100,000
Antamok	0.10	2,750,000	0.07 (a)	1,925,000
Atok	0.01	100,000	0.04	400,000
Baguio Gold	0.015	194,835	0.025	325,000
Balatoc	1.35	6,000,000	1.10	6,600,000 (b)
Benguet	1.00	6,000,000	1.40	8,400,000
Big Wedge	.....	.....	0.04	311,077
Coco Grove	.....	.....	0.02	300,000
Demonstration	.....	.....	0.04	400,000
Ipo	0.015	140,932	0.016	131,152
I. X. L.	0.0425	637,500	0.08	1,200,000
Phil. Iron Mines, Common	10.00	400,000	15.00	600,000
Phil. Iron Mines, Preferred	.....	.....	0.80	32,000
San Mauricio	.....	.....	0.05	477,500
Suyoc	0.01	125,000	0.02	250,000
Tambis	.....	.....	0.01	39,359
United Paracale	.....	.....	0.05	551,176
		17,048,267		22,042,264 (b)

(a) Board was to meet in January and declare " at least 1 centavo," it was reported; 6 centavos has already been paid.
(b) Of this amount, approximately 4,225,000 pesos was paid to Benguet by virtue of its ownership of Balatoc stock.

Exports of Base Metal Ores for First Ten Months of 1938 Compared With Same Period of 1937

	1938 Quantity, Kg.	1938 Value, Pesos	1937 Quantity, Kg.	1937 Value, Pesos
Iron	637,640,000	3,320,947	533,030,746	2,360,778
Chrome	66,138,132	1,564,743	44,106,202	836,749
Copper	21,597,844	1,090,935	13,177,652	501,731
Manganese	50,571,861	911,443	9,025,054	185,076
		6,888,068		3,884,334

Africa



Mining industry prospers. New capital invested on Rand alone in 1938 exceeds £12,500,000. The outlook for base-metal producers is bright

George L. Walker

Epsom, Surrey, England

AFRICA is prosperous. The mining activities there have made that continent relatively more prosperous than any other over the past several years. The prosperity has grown to such an extent that mine operators in several districts are complaining that the further expansion of their activities is retarded by the shortage of native labor. Yet a British commission has just reported, after an extended survey, that the native population is increasing faster under the new conditions than it did under the old.

Investigation of some of the ancient gold mines in the Sudan has been under way for two or three years, but no important results have yet been reported. So far as can be learned, the expected vast mineral discoveries in Abyssinia have not materialized. The Italians are recovering some gold there, apparently very little; but the future may have a different story.

East Africa's gold-producing possibilities seem to have diminished during the past year. Though extensions of the veins are being found in some of the mines being worked in Kenya Colony, it has become increasingly apparent that the sensationally rich discoveries made there a few years ago were the outcrops of only small tonnage deposits. In Tanganyika Territory (held by British under mandate) the excitement over the Lupa gold field has subsided somewhat, but the prospect is still good that important producers may be developed there. In the western part of the Territory a subsidiary of Kentan Gold Areas has continued development work and equipment of the property south of Lake Victoria, and regular production is expected to begin early in 1939. This gives every promise of proving a big producer from medium-grade ore which occurs in shear zones over more than usual widths for gold.

Activities which are destined largely to expand Africa's already great mineral output have tended to concentrate even more than hitherto in the Union of South Africa and adjacent territory, in Northern Rhodesia, and in the Gold Coast Colony.

Witwatersrand's gold-mining region witnessed the greatest activity. According to J. A. Agnew, the Witwatersrand production for the year to June 30 last was 11,428,853 fine ounces, a new high record for all time. The average grade of ore milled was 4.430 dwt. per ton, a new low record. As recently as 1932 the average was 6.493 dwt. Huge investment of new capital, a total of £12,513,972 during the year, made possible extensions to the plants of older mines, completion of the equipment of new producers, the sinking of shafts on properties proved by drilling, and a campaign of exploratory drilling which is proving the continuance of the Witwatersrand gold measures for a distance of approximately 150 miles southwest far into the Orange Free State. This work is already indicating that the Witwatersrand, the greatest gold-producing district so far developed, is again to be doubled in size and output.

The southwesterly possibilities of the Witwatersrand gold measures are greater now than ever previously because of technical advancement. Electrical prospecting and fuller understanding of the geology of the area help in locating drill holes; experience has made the results of drilling more intelligible; shaft sinking through the saturated overlying dolomite has been made practicable by improved cementation, and the higher price of gold has added enormously to the value of all Witwatersrand ores. Ability to treat lower-grade ores profitably has added greatly to reserves, the milling of ores previously left in stopes accounting for the rapid fall in the average richness of the tonnage treated, previously mentioned. Values being proved by drilling, deep development in the western area is now practicable. It is going forward.

Northern Rhodesia's copper production set up a new high record at 203,964 long tons against 182,044 in the preceding fiscal year. Roan Antelope produced 75,253 tons, against 69,560; Rhokana 76,275 tons, against 75,254, and Mufulira 52,436 tons, against 37,230—all long tons. Capital expenditures by all three companies were relatively heavy during the year under review. Roan Antelope is equipping for an annual production capacity of 120,000 short tons and Mufulira for 108,000 short tons. Rhokana has practically completed plant expansion which was intended to make its productive capacity 120,000 short tons of copper a year, and Chairman Geddes has declared that it is "substantially in excess of that figure." The same will probably prove true of Roan Antelope and Mufulira also.

After staggering along uncertainly over a long period of years, its prospects alternately brightening and darkening, the property of Rhodesia Broken Hill Development Company, in Northern Rhodesia, has been proved to contain the makings of an important zinc-lead producer. As the mine is in a very wet area, production hitherto has come from surface workings. Now pumping equipment has been provided and a pump shaft sunk to 1,115 ft., which will be its final depth, as the orebodies proved by diamond drilling are almost wholly, or wholly, above that level. Anglo American Corporation of South Africa, which supplies the company with consulting engineers and managers, estimates that drilling so far indicates approximately 1,200,000 tons of sulphides averaging 35.5 per cent zinc and 23.5 per cent lead, and 2,200,000 tons of oxides averaging 23 per cent zinc and 7 per cent lead. The average of the oxides is 1 per cent vanadium, but a large portion carries none.

Efforts to develop gold mines in Northern Rhodesia have had discouraging results. Luiri Gold Areas reports finding extensions of the small but rich Dunrobbin vein, but appears to be proving only an unimportant tonnage. Rhodesia Minerals Concession has decided to expend some £5,000 further on the development of its Chakwenga gold discovery.

Southern Rhodesia has made hardly any contribution to the discovery and development sensations of the past year. The many producers, some 600 of them, are benefited by the higher price of gold, of course, but their aggregate output is not up to expectations. Developments at depth in two or three properties have been favorable; in some otherwise.

Profits in no case were outstanding.

Gold Coast production and developments continued to cause comment. They were such, indeed, as to guarantee further expansion of activities in that now important gold-producing district. Marlu brought increased plant capacity into service and Bibiani will soon complete a similar expansion. Both are paying dividends. Ashanti Goldfields seems likely to double its mill soon, as the mine has outgrown the present milling capacity. Deep developments by Ashanti have revealed sensational values over widths of 10 to 30 ft. The companies working on the Banket reef are doing well.

Diamond mining was somewhat depressed during the year, international unsettlement diminishing the demand for and sale of stones. Development work was nevertheless continued and the known diamond resources of the continent were increased by discoveries and the extension of those deposits already being mined.

In the Belgium Congo, Union Miniére du Haut-Katanga has increased its productive capacity probably to over 200,000 tons of copper annually by opening and equipping some of its western mines. It has so reduced its production cost that it will be able to operate profitably on any price for the metal at all likely to be experienced. There has been a good market for its cobalt and radium byproducts, but its copper output is being restricted somewhat by the international curtailment arrangement. Tin production in the Belgian Congo is being restricted by agreement with other producers. Gold output is reported to be maintained, though definite information is unobtainable.

Africa is a considerable producer of chrome, vanadium, cobalt, and the platinum group of metals, and it is interesting to note that the demand for all these metals has continued to expand. It will be recalled that Africa first gave promise of becoming a great producer of diamonds, then of gold, and later of copper, and that it has kept every one of those promises.

Australia

Gold mining continues its expansion. Yield exceeds that of 1937, Western Australia accounting for the bulk of total. Dredging activities multiply

Peter G. Tait

Melbourne, Australia

WITH the price of gold at a premium of 25 per cent on London, gold mining in Australia continues to expand. The output of the Australian states (not including New Guinea) for 1938 will exceed last year's production of 1,380,431 fine ounces and will be approximately double the output of the year 1932, when 714,135 fine ounces was produced. During 1938 gold realized as much as £9 4s. 2d. in Australian currency, which compares with the old standard price of £4 4s. 11d. One of the principal results of the higher price is that the grade of ore being worked is now much lower. In the record year, from a production standpoint, of 1903, the average grade of the ore treated in Western Australia was 21.62 dwt., whereas in 1937 it had fallen to 6.64 dwt. per ton. This means that, despite the larger tonnages being treated today, the gold output of the Western Australian mines is less than half what it was in 1903. Improved mining and treatment methods (notwithstanding the 40-hour week for underground men and 44 hours on the surface) have enabled the tonnage to be handled with fewer men than in former years.

It has been estimated by the Australian Mines and Metals Association that 52 per cent of the gold produced cost over £4 5s. per ounce, and that the average cost of the whole output was £5 13s. per ounce approximately. It will be seen, therefore, that the industry depends largely on the maintenance of a gold price around £7 sterling, equivalent to £8 15s. Australian.

Dividends declared by Australian gold mines during 1938 (to mid-November) amount to £2,780,280, and already exceed 1937 figures. Progress is indicated by the fact that in 1932 only eight companies were on the dividend list, the amount distributed being £260,000, whereas today dividend payers number 47.

Since the discovery of gold at Kalgoorlie 45 years ago, West Australia has produced 43,205,548 fine ounces of gold to the value of £205,000,000. The yield of that State for 1938 will exceed the 1937 output of 1,000,647 fine ounces.

Great Boulder Proprietary to the end of 1937 treated 5,192,219 long tons for 4,853,260 fine ounces and has distributed £6,495,340 in dividends, on a paid-up capital of £233,000. Ore reserves total over 1,000,000 tons, averaging 6.9 dwt., or more than three years' mill supply. Working costs are 29s. 6d. a ton.

The other main producers on the Kalgoorlie field are the Lake View & Star, treating approximately 50,000 tons monthly, Boulder Perseverance, North Kalgurli, and Paringa. In other centers there are the Wiluna, Big Bell, Sons of Gwalia, Triton, and Norseman mines. Wiluna Mines treat over 50,000 tons monthly, though the grade, dropping with depth, is about 4 dwt. The Big Bell, at Cue, with 30,000 tons' monthly milling capacity, has ore reserves exceeding 3,000,000 tons assaying 3.7 dwt. per ton. Working costs are expected to average no more than 10s. per ton.

Important gold mines in other States include Mount Morgan and Golden Plateau, in Queensland, and New Occidental, in New South Wales. Mount Morgan has large reserves but is faced with the problem of economical mining in extensive old workings. The ore is now wholly won in open cut, with removal of 3 tons of overburden to 1 ton of ore. Oxidized and sulphide ores are treated in separate mills of a combined tonnage of approximately 70,000 per month. The management aims to increase the sulphide tonnage to at least 10,000 tons per week. A problem has been the realization on concentrates, now shipped to United States. A reverberatory is nearing completion.

Golden Plateau's future is uncertain. Since milling began in January, 1934, the company has distributed £735,000 in dividends on a paid-up capital of £113,750. One of the most

promising gold mines in the eastern States is the New Occidental, at Cobar, New South Wales, incorporating three old mines—the Occidental, Cobar, and Chesney. Ore reserves exceed 1,000,000 tons. A new plant to treat 18,000 tons monthly has been installed.

In Victoria, the Bendigo field has no outstanding producer at present, and there are no notable developments to record, though much activity prevails. Interest is mostly centered on the Chewton field, where the Wattle Gully mine is the most promising. In Victoria, no mines are operating on a large scale, but there are quite a number of small, comparatively rich producers.

Gold dredging has revived in recent years, notably in New South Wales and Victoria. The largest bucket dredge, that of Wellington Alluvials, on the Macquarie River, in New South Wales, has a capacity of 250,000 to 300,000 cu. yd. monthly. On 18 miles of river leases there is about 38,000,00 cu.yd. of wash up to 65 ft. deep. Broken Hill Proprietary, father of this enterprise, is developing another area at Burrendong, and plans to build a dredge.

Cock's Eldorado is the largest bucket dredge operating in Victoria. It has a monthly capacity of 200,000 cu.yd. and can dig to 90 ft. In the same district Cocks Pioneer Gold & Tin Mines is working alluvial ground by sluicing.

A dredge has been installed at Newstead, near Castlemaine, Vic., by the Victoria Gold Dredging Company. Capacity is 175,000 cu.yd. monthly. The quantity of wash available is estimated at 15,000,000 cu.yd. averaging 3.64 grains per yard. Dredging began in July. In the Ovens Valley, northeast Victoria, the Adelong and Bright Valley dredges are at work. The latter started in October, 1937.

In New Guinea, Bulolo Gold has six dredges actually working, will start a seventh next March, and is to build an eighth. Reserves at date of last report were 192,000,000 cu.yd. In Papua, the principal mine is Cuthbert's Misima, which is profitably treating nearly 3,000 tons monthly.

In the "Dead Heart of Australia," a new field has been opened at Tennant Creek, but it suffers from its remoteness. However, five small batteries, several with cyanide plants, are working. Ore under 15 dwt. per ton is not profitable.

Tin is produced in northern New South Wales, Queensland, and in Tasmania, mainly by sluicing plants. One of the most important Tasmanian producers is the Briseis, which is working wash overlain by a heavy basalt deposit. The present company has paid its first dividend. Normal monthly production is about 50 tons tin oxide of 72.5 per cent. Tin lodes are being worked by the Mount Bischoff, Aberfoyle, and Story Creek mines in Tasmania. Tableland Tin Dredging is to erect a dredge with a capacity of about 350,000 cu.yd. monthly on Return Creek, Mount Garnet, Queensland. Estimates show a total of 80,000,000 cu.yd. averaging 0.5 lb. tin oxide.

Mount Lyell, Australia's principal copper producer, for the first time treated over 1,000,000 tons of ore in its last year, and produced 12,407 tons of cathode copper, 1,000 tons less than in the previous year, this because the lower-grade deposits in the West Lyell and Tharsis mines are being worked.

The doyen of Australian silver-lead mines is the Broken Hill Proprietary. It has ceased production owing to exhaustion of reserves. Today, its interests lie mainly in iron and steel. However, reserves of the North mine exceed 5,000,000 tons, and the South and the Zinc Corporation have proved reserves of 3,000,000 tons each. In addition, New Broken Hill Consolidated is expected to open up large tonnages. This property will be worked in conjunction with the Zinc Corporation. Besides Broken Hill, the principal silver-lead-zinc producers are Mount Isa, in Queensland, and the Electrolytic Zinc Company. Lake George Mines, near the Federal Capital Territory, are being equipped.

Philippines

(*Continued from page* 63)

The base-metal industry has grown steadily, and the value of ore exports amounted to 6,888,000 pesos for the first ten months of 1938, as compared to 3,884,334 for the same period in 1937. Iron-ore shipments dominate the industry, with copper a poor second. Chromite mining has fallen off considerably, shipments to the United States having been curtailed, because of surfeiting of the market. The high-grade deposit of the Florannie Mining Company, in Camarines Sur, has been worked out; outside of a few insignificant tonnages, the Philippine chromite reserves are in Zambales. Copper concentrate from Lepanto (Mountain Province) and copper ore from Hixbar (Catanduanes Island) are going to Japan regularly. Scattered shipments of manganese are still being made. The year has proved that Philippine manganese ores need treatment.

Contrary to the trend in 1937, mining profits increased in ratio to the increased production. In 1938 attention was concentrated on lowering costs and raising efficiency. Many supplies were cheaper. The volume of equipment imports was smaller. Fewer mills were built. Many boom-day companies went out of business and many worthless prospects were abandoned.

Mexico

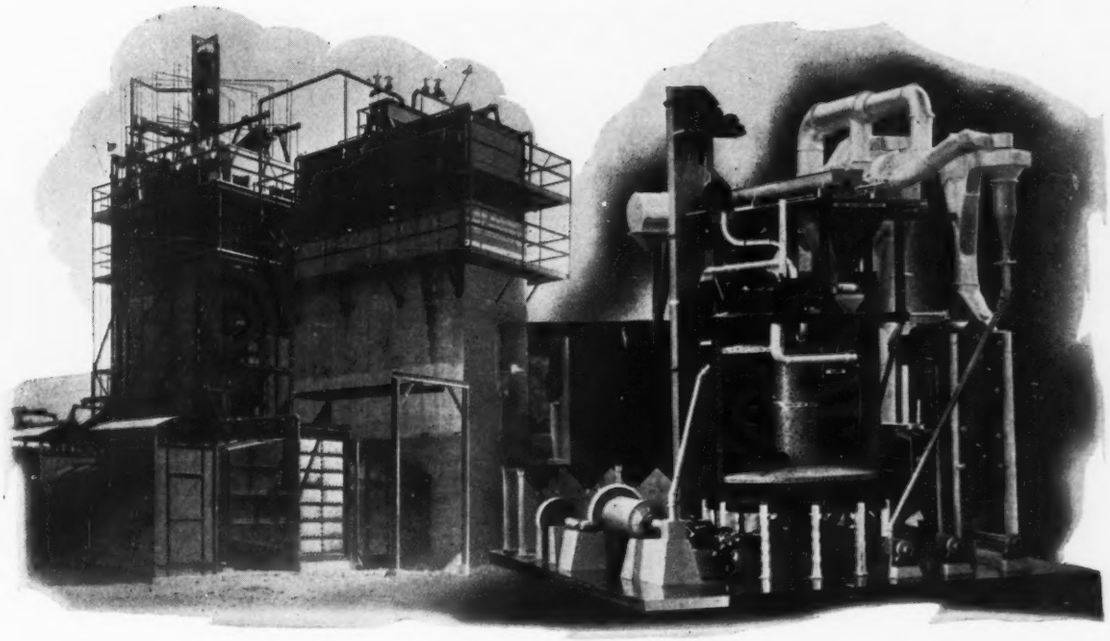
(*Continued from page* 62)

wages, salaries, and indemnities, 28 per cent for supplies, power, royalties, freights (exclusive of taxes), and miscellaneous; and the balance, 38 per cent, for taxes. The latter included the production tax, the capital export tax, the special 12 per cent export tax, the pertenencia tax, the property tax, the income tax, the invoice tax, railroad freight and express taxes, duties, and various other taxes.

Some increases in freight rates on minerals have become effective since the management of the National Railways was assumed by the workers last May. Other efforts made by the Labor Administration have been defeated. The increases cited have been effected through modification of regulations, cancellation of old contracts, and other circuitous ways. The financial condition of the roads is precarious, rolling stock is scarce, accidents are frequent, and the service is getting worse. Yet the railway men seek higher salaries.

The Cooperative Movement — One can now understand how it is that some owners have found it impossible to operate their properties owing to prohibitive costs incurred when complying with the exorbitant demands of labor. Denied permission to shut down, they continue to operate until their resources are exhausted and they are forced to stop, though now legally liable to their employees in various ways. Thereupon the employees, organized into a so-called cooperative society, take control and soon receive or take for themselves privileges previously denied the owners that facilitate successful operation, such as cost reduction measures, tax exemption, and the like. Yet no property so conducted has been successfully run thus far. Already the cooperatives have been exempted from the 12 per cent export tax, and further tax exemptions are proposed, arousing opposition because of the inequitable treatment this connotes. The movement, previously inconspicuous, was speeded up in 1938. Moreover, on Dec. 20, Congress approved a law creating a board for encouraging mining which really, by its terms, permits the Government to enter the mining business and to aid the cooperatives in many ways. The question may be raised as to whether the cooperative technique may not be just another means of expropriation.

Looking ahead, the future of metal mining in Mexico appears most uncertain. Much depends on the attitude that the present Administration in Washington will take. Undue tolerance of encroachment on private rights under various legal pretexts will surely result in new abuses.



Trends in Technology

CURRENT trends in technical practice are rarely to be discerned in the space of a single year. The evolution of new developments and their adoption proceed too slowly. Once headway is gained, however, advance may be rapid, at times too rapid and requiring subsequent correction. A reviewer scanning a twelve-months' progress must really consider a longer span, to interpret what he sees correctly. In the following summaries of the technical field this difficulty is met in various ways. In general the year's progress cannot be defined with sharpness.

Once again, the Lake Superior Iron Country invites attention by reason of the changes that are being made in methods of mining and transporting ore in open pits and its subsequent beneficiation. Here one sees the results of a movement long under way and still experimental. Ore dressing in general appears to be re-traversing old ground with profit. The metallurgy of the base metals shows itself far from dormant, especially in the electrometallurgist's corner. And the field of non-metallics continues to present new opportunity. Especially noteworthy is the summary of trends in mining geology in both theory and practice, beginning on page 69. On the whole, the reviewers for 1938 report material progress.

Some Trends In Mining Practice

Conditions favor use of more effective ways of gold winning. New transport methods are rapidly evolving in open-pit work

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PRODUCTION of minerals during 1938 continued to show steady gain over that of preceding years, even though the combined industrial index has fluctuated. Tonnage mined has increased, metal recovery has improved, losses have been lessened, but the nemesis of mining enterprise is lower grade of ore and failure in the case of the base metals to find new fields. Geologists must rise to this challenge. On ore genesis we theorize volubly, but this does not insure discovery. An outstanding contribution of economic geology to the mineral industry is the belated recognition of the relationship between rock structure and ore segregation.[1]

Geophysics, in spite of intensive inquiry, has not yet given the "open sesame" to new ore deposits. Baffling obstacles of observation and interpretation are encountered in instrumental prospecting for metalliferous masses. Much laborious work has yet to be done.

The airplane is increasingly useful for geological reconnaissance. It facilitates and accelerates geological mapping. Rough classification of a vast terrain is quickly accomplished by aërial geologizing. In other ways also the airplane has aided the mineral industry.[2]

No marked improvements, either of machines or technique, in mechanical proving of ground by core or sludge drills are noted.

During recent years there have been no sweeping changes in the pattern of metal mining techniques: there are fewer and larger enterprises, but the problems of large low-grade ore production are well understood. The metallurgist's ability to treat imposes an obligation upon the miner as to what to provide both of kind and quantity. There is a reciprocal relationship. The mill flowsheet begins in the stope, and the millman must know the nature of that environment. Similarly, the quarryman or producer of direct smelting ore must have knowledge of requirements at kiln or furnace.

The last word has not been written about the location of treatment plants. I predict that more and more ore will be partly treated underground by hydrometallurgical processes. At the Ohio Copper Company's property, in Utah, where the branch-caving method of mining was initiated in the West, collapsed areas are being leached profitably. The lean overburden stripped from Sacramento Hill, at Bisbee, yields the cheapest copper of the district by heap leaching. In eighteen months ended July 1, 1938, 10,000,000 lb. of copper were won by leaching, in place, an abandoned ten acres of caved land at Ray, Ariz.

Placer Mining—It is but natural that the impetus given to gold mining by the great increase in the price of the metal should result in many novel innovations of practice. Giant strides have been taken in this field. A beneficent government would now build impounding dams to encourage hydraulicking. Amortization of cost is anticipated from revenues based on "yardage in the bank." It is recorded that hydraulic giants are in use for stripping overburden and scouring clay-filled channels at a limestone quarry in West Virginia.

The use of mechanical excavators, other than floating dredges, with movable or stationary washing plants, for low-grade gravels is noteworthy. Although each deposit presents its own problems, small, shallow accumulations of auriferous gravel, too lean for hand placering or hydraulicking, are being equipped with these devices and successfully operated. Where the quantity of black sands interferes with gold recovery on riffles, jigs may be important units in the flowsheet.

At Goodnews Bay, Alaska, platinum sands were worked progressively with dragline units, standard bucket-line dredges, and later with pontoon-type boats. All pontoons are electrically welded and rigidly reinforced for foundations and footings.

Drift mining of buried gravels challenges the ingenuity of operators. A novel method of meeting an unusual situation has been used at Blue Ravine Channel, Folsom, Calif., where cased boreholes to bedrock were dewatered by centrifugal and later deep-well turbine pumps before shaft sinking was possible. More recently the mining of a "gutter" overlain by beds of quicksand by the Australian method in British Columbia suggests ways and means of exploiting similar deposits elsewhere.

Open-pit Mining—Quarrying for stone and open-pit mining of iron and base-metal ores has been characterized by continued improvements in explosives for wholesale breaking of ground, of equipment for handling broken rock, and in transportation systems. Steam shovels for large-scale operations have been supplanted by electric-power shovels having greater digging ability, both in speed and capacity, without adding to weight. Special alloy-steel, new welding methods, more excellent design are noted. Increasing use of aluminum in booms of shovels and draglines is predicted, although welding and fabrication add to cost.

As the open-pit mines on the Lake Superior iron ranges become deeper, mounting haulage costs are met by modification of transportation systems: tractors, trucks, and other mobile units take the place of spirals and switchbacks. An analysis (not yet completed) of the whole problem by L. C. Moore is being presented in the *Engineering and Mining Journal*. Where the limit of depth for open-pit mining approaches, conveyor belt systems of transport are being developed. It is not unlikely that the open-pit copper mines of Utah, Arizona, and New Mexico, before depth forces a change to underground methods, will be completed by modified mill-holing practices using excavators of great mobility and conveyor belts to carry ore to centralized shafts.

[1] Personal communication Dr. Carl D. Hulin, University of California. Also, "Structure at Pachuca," Wisser, Trans. A.I.M.E., Vol. 126. "Structure and Mineralization, Colorado," Singewald & Butler, *Ibid.*

[2] Symposium on Aviation, Trans. A.I.M.E. Vol. 126.

A colossal enterprise is well advanced at the Clay mine, Morenci, Ariz. All open-pit engineers welcome the description of "preliminary stripping" given by Lawson in *Mining Technology,* September, 1938, A.I.M.E.

Mine Development and Equipment —Large-diameter core drills are now used for geologic exploration of dam sites, foundations for bridge piers, skyscrapers, and other massive structures; also for ventilation and other purposes in underground mines. Following the boring in 1936 of a 5-ft. shaft with specially designed equipment at the Idaho Maryland mine at Grass Valley, Calif., a similar shaft, 5½ ft. in diameter, has recently been completed at Ely, Minn., in much less time, after completely redesigning the equipment used.

Concrete continues to be used for the support of permanent mine openings, in shafts, stations, ore pockets, and haulageways. Its obvious advantages fully justify the cost.

Outstanding achievements are found in improvement of machines used underground. Time-saving and labor-saving devices meet the issue of increasing wage scales and the burdensome prescriptions of government. Better materials are used, power is more efficiently applied, standardized practices are in vogue. In the design of drills, it is improved alloy steel rather than higher air pressure that at present gets results. For handling broken rock underground improved scrapers, slushers and loaders find application in drifts and stopes.

Studies of rock movement and ground subsidence are well advanced. Hitherto the work has focussed on reducing risks to life and property, but a vista of opportunity unfolds for changes in mining practices as knowledge of the mechanics of rock movement increases. Possibly when with greater assurance we can predict the manner of behavior of rock masses under variable conditions of stress and strain, naturally or deliberately induced, we may apply this knowledge to make mineral deposits mine themselves. In reality caving methods, which yield so large a part of ore tonnage mined, depend upon these things.

Safety and Health — The human unit is still the most important agency of production; hence it is not surprising that attention centers around the reduction or elimination of occupational hazards inherent to mining. Humanitarianism compels, and legislation dictates, a program dealing with employees, their health and protection from injury. Illumination, ventilation, air conditioning, the allaying of dust —all these matters are being scientifically studied. The United States Bureau of Mines pioneered in this field and maintains leadership, but it is gratifying to note the enthusiastic response of management.

Mining Geology Looks Toward Realism

The trend in ore deposition theory. Laboratory techniques. Field application. Geology's place in mining. Geophysical prospecting

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MORE than usual emphasis will be put on current trends in the theory and practice of mining geology in these paragraphs and less on reviews of technical papers and current foci of activity. Most of the papers on mining geology currently published in the technical journals in the United States have been reviewed, but due to limitations of time and reference facilities the world literature could not be covered adequately. Inasmuch as current literature as an index to the trends lags from six months to five years or more, the best idea of the trend is gained by conversation with the leaders in the science, though direct contacts are difficult to make. Letters were written to a number of prominent professional geologists requesting their ideas on the current trends in the philosophy and the application of mining geology. The replies received have been incorporated and where possible acknowledged and quoted. Contributors are Donald McLaughlin, E. C. Eckel for the United States Geological Survey, Ira B. Joralemon, Augustus Locke, Alan Bateman, W. H. Newhouse, T. S. Lovering, Samual Lasky, H. E. McKinstry, and S. F. Kelly.

Theory on Origin of Ore Deposits —McLaughlin's letter describes much of the present trend in theory and the following is quoted:

"A trend in our thinking in mining geology is a growing dissatisfaction with over-simplified concepts of ore-forming processes. This encouraging change can, I think, be attributed largely to the contributions of geochemists and geophysicists of the purely scientific sort, on one hand, and to the close and realistic studies of details of ore deposits by a number of mining geologists, on the other.

"The results slowly coming in from highly skilled scientists who are investigating basic questions, such as deformation and failure of minerals and rocks under high pressures and temperatures, separation of substances from solutions under conditions previously beyond the range of laboratory techniques, and various problems related to the concentration of elements in a crystallizing magma, are of highest importance in restricting geological thinking to the physical-chemical facts. Some of Bridgman's recent experiments and his ideas on failure of materials, Griggs' experiments on failure of rocks under all-sided pressure, and various research projects involving simple systems near the critical temperature may be cited as types of investigations that are providing geologists with much needed background. Niggli's recent book, published in 1937, "Das Magma und Seine Produkte," deserves special mention in this connection, not as a contribution specifically prepared for economic geologists, but as a presentation of current results and thought on magmatic processes, which students of ore deposits who glibly discuss derivation of metals from magmas cannot ignore without risk of being reduced to an amateur standing. And in these various masterly contributions there is a healthy new note of caution which geologists might well take to heart against too comprehensive application of the results and ideas to exceedingly complicated natural systems.

"More strictly in our own field, I feel that men engaged in professional work, who are investigating all features of their ore deposits with a new thoroughness, are doing a most important job, particularly in improving our understanding of structural features, not only with regard to details of local value, but with regard to broader relations of ores to regional or even continental features. The geology of scattered areas is becoming known with a degree of precision which marks a notable advance on earlier work—the sort

of precision that makes geology really effective in mining. Unfortunately, not enough about this sort of thing has been published, but I believe it deserves recognition as a current trend that is important. Such work is also providing a new basis for bolder speculations concerning relation of mineral districts to features on a continental scale, and I hope more of us are going to be willing to undertake such ventures; or devise means of testing some of the ideas. Such work as . . . . . the careful geologic studies at Sudbury under Graton and Yates or the work at the Homestake might be cited as examples of the close realistic studies in progress in many places; and I think Billingsley and Locke's efforts to recognize regional structural controls and to see their expression in the details of a number of districts is an excellent example of the broad type of study mentioned. They are serving an important purpose in directing attention to these neglected and vitally interesting major problems.

"A contribution of very different sort that I think deserves mention is J. S. Brown's short article on the historical background of downward secondary enrichment theory. It is most timely to attract attention to the all too common habit of overlooking valuable earlier contributions and of uncritically accepting statements that have been sanctified by repetition.

"Possibly Balk's book on structure of igneous bodies and Mrs. Knopf's new book just off the press on structural petrography might be mentioned as current works not directly related to economic geology, but of value in making the structural concepts of Cloos and Sander (as well as their own valuable work) easily accessible to busy professional geologists, who may find much of value in them in relation to structural detail in a number of districts."

Importance of Fundamentals

Lasky and Eckel in their communications emphasized what McLaughlin says about the accelerating importance of physics and chemistry as a background for geological theory. Hubbert in an interesting paper (Ref. 1) discusses the integration of geology and geophysics and the training of geologists. He states that many geologists are inadequately trained in chemistry and physics, that they avoid mathematics, that poor students in mathematics select geology as a study, and implies that inability in mathematics means a low intelligence quotient and therefore that geologists as a class are a selected group subnormal in intelligence. There is much in this paper that geologists should consider seriously; much which they should challenge. The leading departments of geology at universities are emphasizing the fundamental sciences more than formerly. Then, too, a marked increase in the publication of the physical, chemical, and mathematical treatment of geological problems is apparent when the current issues of *Economic Geology, Journal of Geology* and *Bulletin* of the Geological Society of America are inspected (See Refs. 3, 4, 5, 6, 7, 10, 11, and 26 on page 72).

There are few *mining* geologists of note who do not understand the broad fundamentals of chemistry, physics, and mathematics. They are not likely to be experts both in these subjects and in their chosen specialty. Few could cover the necessary ground and keep up to date in it. Mining geology, for example, is essentially a field science with a base of mining engineering, and one ventures to say a mining geologist well grounded in fundamentals will yet need ten years of field experience to be worthy of the title "expert." Who will define intelligence? Are geologists to be judged by ability or training in mathematics or by what one might call the imagination quotient, the wisdom quotient—or what? Doubtless economic geology will break up into several fields more or less distinctly separated and future progress will be more and more through cooperative effort of the specialists. Indeed, such a separation has already taken place, and the trend will doubtless accelerate (Ref. 2). At present it seems we must be content to emphasize largely detailed structural mapping and quantitative work on wall-rock alteration. These give the quickest and most obvious results.

This reviewer's impression has been that the geophysicists active in *mining* work have been on the defensive for several years because of their lack of substantial success in finding ore. Many geophysical failures in the past have been due to the neglect of the powerful tools mining geology has to offer, including particularly detailed structural mapping and wall-rock alteration. "Mining" geophysics ought to take up where structural geology leaves off.

Bateman refers to "the bombshell that Holmes threw into the science by his statements on the lead-uranium ratio and the replies thereto by Wells, Knopf, Graton, and Keevil." Undoubtedly Holmes' paper (1937, Ref. 7) and the ensuing discussion (Refs. 8, 9, 10, and 27) has been an important contribution to theoretical geology. Holmes' theory, like Spurr's on ore magmas, is causing beneficial stock-taking by the geneticists.* His argument, in short, is that since the atomic weight of igneous rock-lead which is partly lead resulting from the radioactive disintegration of uranium and thorium in rocks during geologic time, partly common lead in the rock, is different from (lower than) ore-lead, ore-lead cannot have been derived from igneous rock. Keevil (Ref. 4) says that "the calculation of the atomic weights of rock-leads from a new series of thorium-uranium ratios" indicates that rock-lead and ore-lead have nearly the same atomic weights. He concludes that the theory of the derivation of ores from igneous rocks is strengthened.

Some will not agree that this conclusion is indicated. The current theory has appeared more vulnerable the last few years than for several decades largely because of new evidence on volcanic gases, the possible source of silica from wall rocks, and weaknesses, as indicated by field evidence, in the conventional straight-line differentiation theory of which N. L. Bowen is perhaps the chief supporter. De Lury has written an interesting paper on some objections to the current theory (Ref. 27). This reviewer believes that a hypothesis which postulates that the "main stem" from which magmas and ores are derived is primordial metal-charged gas kneaded out of the earth's interior and released by deep cutting faults has much to commend it, for one is impressed with the importance of the rôle of gaseous emanations in volcanic and igneous activity, the increasing examples of igneous rocks derived by replacement of country rock,** the evidence that many intrusives associated with ore are floored, and the common finding that ore is later than the associated igneous intrusives and their pegmatites and aplites. Briefly, the hypothesis does not exclude the probability that some intrusives are secondary sources for ores, or that some or even most magmas move after generation, or that most ores are probably deposited from liquid solutions. The new numerous objections to the current theory should relieve some from the apparently overpowering need of postulating an intrusive in depth if one cannot be found at the surface associated with the ore.

Laboratory Work

The recent trend of laboratory experimentation on fundamental geophysics and geochemistry is gaining momentum and will have beneficial effects on theory when fully analyzed and integrated. The pressure work at Harvard, as mentioned by McLaughlin, is noteworthy. Some of the results were published in 1938 by Birch and Bancroft (Refs. 5 and 6).

* Holmes second paper (Ref. 31) was available only after the foregoing was written. His argument still seems to have a strong basis, and in addition he indicates the weaknesses—which have been discussed further on in this review—in the current differentiation hypothesis for rocks and ores.

** Lasky in his letter refers to ". . . the growing realization that many so-called igneous rocks, *including* some monzonites associated with ore deposits, are actually products of replacement of sediments." Holmes gives a long list of references on this subject (Ref. 31, p. 836).

There is an encouraging tendency for laboratory work on genesis in geochemistry to break away from empirical forms and to start with fundamentals. This is indicated by papers such as those of Frondel (Ref. 11) Verhoogen (Ref. 3), and Schmedeman (Ref. 30). The latter paper shows the weight now being given to the possibility of acid ore solutions. Spiroff's paper (Ref. 29) shows the possibility of supergene magnetite.

The latest writing on genesis from the philosophical viewpoint is more fundamental in scope. Witness Niggli's thought-provoking work (Refs. 12, 13, and 14). The currently fine work being done in petrology and petrography should be mentioned and is of outstanding importance in genesis. These two fields are so intimately related to ore genesis that no mining geologist can afford to neglect them. It has seemed to this reviewer that after the publication of Bowen's classic work "The Evolution of the Igneous Rocks" in 1928 (Ref. 19) there was an interval when little new was contributed.

Some New Ideas

Recently in this country Fenner initiated new ideas (Refs. 15 and 16). The credit for reviving interest in the rôle of volcanic emanations in ore deposition must go to him and his co-workers in the geophysical laboratory at Washington. The data were summarized in 1924 in the *Journal of Geology* (Ref. 17), when the geneticists were asked to explain what force was available to bring liquid water from the magmas to the zone of ore deposition. So far as this reviewer knows, no satisfactory answer to this query has been made. Fenner (Ref. 18) brought the discussion up to date in 1933 and has been widely quoted. The rank and file of mining geologists for more than a decade seem to have been unduly attracted to the current theory of the origin and differentiation of metals from igneous rocks through pegmatites to veins and to have neglected the possibilities of the gaseous emanations as carriers and depositors of the metals. Recent advances made in petroleum geology, petrology, petrography, geophysics, and the several sciences have been striking as compared with mining geology. Lasky says in his communication ". . . . . there is growing a general iconoclastic attitude; many of the accepted generalizations are probably all right, but each district should be studied on its merits, and should be combed for any facts that may support or contradict current conceptions" (Refs. 20 and 21).

Laboratory Techniques for Mining Geology—Of the new techniques developed for the study of ores and minerals, the system of iridescent filming of minerals on polished sections developed by Gaudin (Ref. 22) is of great value. The contribution is commendable because of the lack of empiricism so common in such research. New improvements in machinery for polishing and techniques of polishing ores are described from time to time. In 1938 Murdock contributed an article on this subject (Ref. 23). William Parrish, describing the use of the Hardy recording photo-electric spectrophotometer in analyzing colors reflected from polished surfaces at the New York meeting of the Mineralogical Society of America, Dec. 28-29, 1938, states that of 100 min-

erals tested each showed unique reflectivity curves, from which the color of the surfaces may be described.

Application of Mining Geology in the Field—Detailed geologic mapping, especially as applied to structure, mentioned by McLaughlin, Newhouse, Lovering, Eckel, Butler, and McKinstry in their communications, is now attracting more attention than any other one feature in the application of geology to mining. McKinstry's letter is pertinent and is quoted:

"One of the most promising of recent trends in mining geology is the increasing attention to structure in the study of ore deposits. This is not a development of 1938 or of any other definite year, but it is recent in the sense that its effective application depends on accurate and detailed underground mapping and it is only in recent years that more than a few mining companies have been maintaining full-time geological staffs under the direction of men qualified by thorough academic training and protracted underground experience.

"The essential features of the modern approach are, first a graphic portrayal of the detailed distribution of metals in the vein or orebody; second a comparison of this with the shape of the orebody as visualized in three dimensions; third an interpretation of this shape in terms of the pattern of controlling fractures. In a surprising number of cases a study of this sort reveals that the distribution of metal values bears a definite relation to the shape or attitude of the fractures and that these, in turn, may be explained by local variation in the strength-characteristics of the wall rock, a variation which may be occasioned by such features as the passage of a fracture system from one type of rock into another or merely by variation from place to place in the attitude of folded beds.

"The recent interest in the structural localization of ore deposits was evident in the symposium held at the A.I.M.E. meeting early in the year and in the anticipation of the volume that W. H. Newhouse is editing under the sponsorship of the National Research Council. Fowler's recently published studies in the Mississippi furnish an example of the concentration of attention on the regional fracture pattern in a district where geological discussion formerly centered about the moot question of the source of the metals. Wisser's work in Pachuca is an excellent example of the fracture pattern of a district in terms of response to stresses. In Grass Valley the studies by Johnston and by Farmin are important steps toward an understanding of vein structure; it is unfortunate that in this camp the publication of maps and sections has been prevented by legal considerations. In Australia a group of geologists have made structural analyses, published in the last year or two. A number of Canadian geologists have been working along the same lines in Ontario and Quebec.

"While microscopic and mineralogical studies have greatly advanced our understanding of ore deposition and while broader philosophic thought bearing on the source and nature of ore solutions has broadened our outlook, the study of the veins themselves as receptacles and channel-ways is still one of the most productive fields for applied geology."

During several decades the mystery in economic geology has been the slow recognition of the fact that detailed surface and underground mapping (100 ft. to the inch and larger), with resultant definition of structural controls of orebodies, is the most effective tool for ore finding. On the whole, economic geologists have been slow to recognize and adopt this powerful tool that accounts for the majority of the orebodies found through geological work.

Field Experience Essential

Two factors have contributed to this condition which also apply to other techniques of mining geology to a less extent. First, most teachers and writers in economic geology are not experienced field men; i.e., they have not spent enough time applying the science in mines to know where to put the emphasis. Nevertheless, their influence has greatly overshadowed that of professional field men, who seldom have the time, facilities, or authorization to do much writing. Second, the influence of the United States Geological Survey methods has been great. Yet these, though admirably adapted to attain the usual

objectives, are not particularly fitted for ore finding in the individual mines, which requires mapping on larger scales, more sustained application, and, in short, a difference in emphasis. The phase of the Federal Survey's publications which attempts to predict the position of oreshoots and advise on ore finding often does harm and certainly seems amateurish to the professional. The Government's most effective and appropriate sphere seems to be in the broader correlations which usually cannot be studied by the mining companies. The usually long period (often three to ten years) between the field work of the Survey and the publication of its reports has been an aggravation to the miners but this has been mitigated to a small extent by pre-publication summaries in the various journals. The truth is, as most of us recognize, that the Survey's effort is largely in the field of pure science, and in this respect it does much of the best work of the kind in the world.

Although in the field the principal emphasis is now being put on detailed mapping and structural control, a number of new field techniques are becoming important. These include aërial photography (Ref. 24) and petrofabric analysis or structural petrology so ably covered in the recent book by Knopf and Ingerson (Ref. 25) and which will be increasingly used for structural work, particularly in schist areas and to work out shapes of intrusives. The magnetometer will probably be increasingly used by geologists not specialists in geophysics because of its effectiveness and simplicity. See Lamey (Ref. 26) for an example of the use of this instrument in mapping.

Three-dimension illustrations, particularly block diagrams, are used more and more in current publications and are destined to see still wider use, especially to displace glass models for demonstration of structure to juries, boards of directors, and mine foremen. The practicing geologist, however, if he knows his mine thoroughly, has the essentials of the three-dimension picture in his mind, and the details on his plans, cross-sections and contour maps.

Roughly, quantitative studies of wall-rock alteration are being used in the Southwest and have been successful in predicting the nearness of ore when diamond drilling and driving headings. The early determination of the *absence* of favorable wall-rock alteration in certain blocks of ground has helped reduce the amount of development work needed.

Microscopical work has, of course, become standard practice in university and governmental research on ore deposition. Its adoption in mining has seemed slow, although it is a valuable tool in ore finding when used for the classification and correlation of rocks, for the study of wall-rock alteration, and supergene enrichment. Even such apparently academic details as paragenesis have become of practical importance in ore finding. For example, in the Hanover district, New Mexico, microscopical work proved the sulphides to be later than and to replace the contact metamorphic silicates. This means that the post-silicate fissures, not the pre-silicate fissures, are immediately critical in ore localization.

An integrated study of the ores, wall rocks, and mill pulps and products is of great importance for mines, especially for those with associated mills. The minerals can be identified and their relationships determined best in thin and polished sections of the ores and then can be readily followed through the mill.

There is much current interest in the quartz spectrograph, though its place in applied mining geology is not clear. In research it has become a valuable tool. For example, the source of vanadium and molybdenum in the outcrop of lead-zinc veins has always been puzzling. Quartz spectrograph analyses have shown small quantities of these and other rare metals in galena and particularly in sphalerite.

Moneymaker and Fox (Ref. 28) in an interesting paper describe the use of large-diameter core drills in exploration, especially for studying the geology of dam sites. The holes are large enough to permit entry for detailed inspection of the walls. The cost, $5-$50 a foot, "frequently falling between $15-$25 per foot for holes not exceeding 100 feet" will, unless lowered, probably limit the use of the method. One hundred foot shafts or winzes can be sunk for $15-$20 a foot with simple, easily obtained equipment. Eckel states in his letter:

"More general recognition of the value of geology in engineering work was evidenced in increased employment of geologists by several Government organizations that build dams and other structures. No new advances in technique, other than in core drilling, were recorded, and, as in the past, there was a notable paucity of new published information on engineering geology."

The Status of Geology in Mining—An accurate idea of the conditions in an industry so large and scattered as mining is difficult for an individual to obtain. This reviewer's impression is that geology is not receiving the recognition it seems to deserve, considering its effectiveness in finding ore. Detailed structural mapping, kept up to date by good men, makes the development of a mine much more of an efficient routine job than any other method of attack can or will, and even when planning stoping and shaft sinking a geological picture seems almost indispensable.

The prestige of geology in mining contrasts unfavorably with its status in the petroleum industry. The geologists themselves undoubtedly are in a large degree at fault. Many have had little or no mining experience—they are often school teachers employed for the vacation periods—often are unable to see clearly what the operator needs, and waste time and money in putting the emphasis in the wrong place—i.e., on excessive theory and not enough on detailed mapping and structural work. Further, it is difficult to measure the quality of the work done. Fine looking maps can be produced which are actually worthless. Seldom, too, is the record clear enough to show the success or failure of the geological work. To be really effective the mining geologist must have some authority and independence in directing the exploration, but he then invades a

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field long held the prerogative of the engineers and operators.

Lack of standards in mining geology—i.e., the highly individual character of the work—was commented on by Locke and Eckel. This characteristic does not help the prestige of the profession. The trend in 1938 is towards realism, which means emphasis on methods which are effective in finding ore. Apparently, too, mining geologists are passing through a period of introspection and inventory.

Geophysics—Reviewing the status of geophysics, S. F. Kelly says:

"Although advances have been made this past year in the techniques of geophysical prospecting, to my mind the important trend today is towards the closer relationship between the research science of pure geophysics and the art of applied geophysics. The methods used in the geophysical search for economic deposits are being applied on an increasing scale to major problems of structural geology. From this there will, in time, inevitably be a feed back and the data gathered in the course of pure research will rebound to the benefit of the exploration geophysicists. The immediate need is probably a conscious and more purposive collaboration on the part of the workers in these two fields.

"Seismic exploration methods are being adapted to the study of crustal structure not only on dry land but also on the continental shelf areas beneath the ocean. Seismograph stations also are being more widely established to take advantage of the information to be gained from small earthquakes, quarry blasting, etc. The data gathered will eventually provide the applied geophysicists with a broader knowledge of crustal structure on which to base their own searches. A further need is a system of bench marks of magnetic and gravitational data to which surveys by these two methods may be tied in.

"Increasing interest in the long-range practical value of geophysical work is being shown by geological surveys of several governments. In some cases this takes the form of areal studies, in others of detail investigation of local mining districts.

"In the field of oil exploration, there is a downward trend in seismic work, a decrease in the use of torsion balances, and an increase in gravimeters. Electrical methods of subsurface mapping are being applied to greater depths, and a new method of soil gas analysis is receiving much publicity. The latter relies on sampling and analysing surface soils for hydrocarbons, and if successful will provide the first direct approach to the discovery of petroleum deposits.

"In mining work, Canada seems to offer the most fruitful field for geophysical prospecting, although a reviving interest is becoming apparent in the United States. The mining industry, however, has lagged far behind that of petroleum in appreciating the true rôle of geophysics as part and parcel of geology, and instead of making impossible demands on it, adopting these methods for what they can really do to the best advantage—help gather geological information."

Older Ore Dressing Practices Re-studied

Gravity concentration gets new attention. Jigging, tabling, sink-and-float, and electrostatic separation are being reconsidered

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ALTHOUGH today there is fair demand for the product of the mine, operators have been severely pressed in recent months. Profits, if any, have been small in many instances. Managements for the most part have been content to run along quietly and have refrained from experimentation in a large way in their plants. Such changes as have been made in the mills consist mostly of the kind which could be made on existing machines and flowsheets; little complete substitution of one machine or process for another of recent development has been made. At various plants, however, manipulation of the flowsheet has resulted in improved recovery, and at some of the newer plants advantage has been taken of new and proved technology.

Crushing and Grinding—For rock crushing in the range of the larger pieces ($\frac{1}{2}$ in. and coarser) there is little new in practice to report. The "rock mill" (in which rock is the grinding media) is out of competition in this field.

In the gyratory crusher, an interesting new mechanical feature is the non-circular space between the concave and its liner, or between the crusher head and its liner (Traylor Engineering & Manufacturing Company, B.P. 480,649, Feb. 25, 1938). Any movement between these numbers causes a compressive action on the filling material in these spaces. Ground fits between liners and seats also are being used more and more on secondary crushers of the cone type for convenience. High-speed gyratory crushers, for secondary or for fine-grinding of hard rock, probably cannot be reported as successful at this date. Bearing trouble has stood in the way. Steel wear is excessive.

Fine crushing, by squeezing of thick beds of ore between jaws or between the crushing members of the gyratory crusher, has not advanced. The condition set up is severe on machinery and the capacity factor is unfavorable. In this field, the rolls and the stamp continue to hold the lead. The large-diameter rod mill, however, is definitely vying for position.

In the field of fine grinding—namely, that range of reduction for which flexible or mobile grinding media are used—there is evidence of much study. Machines new in design and in principles of mechanical motion are in large-scale operation. The new vibratory or shaking type of ball mill is covered by American and German patents. Efficiency and capacity data are not generally available. Two problems, among others, are confronted: (1) the difficult and severe job of vibrating or shaking a massive mill and its ball load, and (2) the probability of excessive wear of mill liners. Excessive slippage between ball load and liners must be avoided. The problem of keeping the sand uniformly distributed in the ball load also presents itself, particularly in batch experimental work.

The open-end mill, developed to give quick discharge, low pulp-load in the mill, and high circulating load, is receiving long-deserved attention. (C. E. Rodgers, Bulletin No. 315, C.I.M.M., 1938.) Discharging through a grate, it accomplishes quick discharge in a more positive way than do the pulp filters between the grate and the mill end. It is also easier to inspect and repair. It may be operated nearer to full critical speed, with the added advantage therefrom of increased capacity per unit of mill volume.

The large-diameter rod mill is demonstrating its ability as a crusher to compete favorably with rolls at the Hayden mill of Kennecott's Ray Mines Division. (A.I.M.E. T. P. 994, 1938). Two 9x12-ft. rod mills are reducing 600 tons of the product ($\frac{3}{4}$ in.) of the coarse-crushing plant to approximately 19 per cent on 14 mesh (81 per cent minus 14 mesh) with only one pass through the mills. Each rod mill has taken the place of four sets of 42-in. Garfield rolls, with their attendant screens.

Comminution by explosive disintegration commercially is still in the "yet-to-arrive" state of development.

Research in crushing has produced considerable literature. Engineers are still looking for a grindability yardstick. W. Gründer (Zeitschrift, V.D.I., 1938, No. 1, 1723), using what is termed a "structure tester," a cone mill coupled to an electrodynamometer, obtains a recorded power-time diagram from which the work necessary to grind a sample from a known initial screen analysis to a definite final size can be calculated.

Grindability is defined by R. M. Hardgrove (*Trans.* Amer. Inst. Chem. Engrs., 34, 131-152, 1938) as the index which represents the number of tons per hour that can be pulverized to a stated fineness on a given pulverizer. Grindability figures for some 200 materials are given. It is observed that the lower the grindability factor of a material, the lower the amount of surface for the same screen size.

A new efficiency-of-crushing figure (Chem. Fabrik 1937, 503-4; Zeitschrift, V.D.I., 1937, 159-161) places the value at 0.5 to 1.0 per cent. This is of the order of magnitude of earlier data by Martin and by Gross and Zimmerly. DeVaney and Coghill (A.I.M.E. T. P. 862, 1938), using the coercimeter, an instrument for measuring surface, have shown that the ball mill, compared to the drop-weight crusher, has an efficiency of 65.5 per cent.

Bond and Maxon (A.I.M.E. T. P. 888, 1938) present new data on grindability of various ores and other materials. On the basis of new surface area produced, a grinding efficiency of about 60 per cent is given; however, these authors point out that the correct measure of efficiency in ore grinding is "unlocking" efficiency, at present indeterminate.

Velocity of hit (*E.&M.J.*, Jan., 1938) is shown to be a factor of importance, inasmuch as it affects both the nature (size distribution) of the crushed product and the efficiency of crushing.

Screening—In screening, the vibratory motion holds supreme. New mechanical ways of imparting the motion continue to appear. Good mechanical methods and sound engineering are what is wanted.

Classification—Classification is always a subject of vital interest in ore milling. So-called mechanical classifiers of the type used in fine-grinding circuits are now chosen pretty much on the basis of their mechanical performance, their ability to handle high circulating sand loads, and the operating attendance required. There is not much difference in metallurgical results delivered; none does perfect classification, and in many cases much in metallurgical efficiency is desired. Improvements in this field may be expected, particularly when the job of classifying is to remove slimes from sand, say, for leaching by percolation, or when the classifier is to function as a concentrator to remove, for example, silica from high-silica iron ore. Full advantage has not yet been taken of known principles. Eddy currents and dead spots in a classifier, more than any other factor, result in inferior classification. In the hydraulic classifier, better classification with less water is an object at which to aim.

R. T. Handcock (Trans. Inst. Min. Engrs., London, 94, 114-121) and A. A. Hirst (Trans. Inst. Min. Engrs., London) have made noteworthy contributions on the laws of motion of particles in a fluid and of fluid resistance.

Classifiers for hindered settling, embodying the constriction plate and high density principles, are appearing under various name plates. An entirely new classifier is in the offing.

Gravity Concentration — This perhaps has had more attention in recent years and in recent months than for decades. Its special fields of usefulness, as well as its delimitations, are better recognized.

The jig, in a variety of new fields, has had a remarkable extension in its application. The hydraulic-pulsion and the synchronized diaphragm-water pump-jigs have found new and extensive application in the ball mill-classifier circuit in milling free-gold and gold-bearing sulphide ores, and in concentrating heavy minerals. In many places, their use on and off the dredge (*E.&M.J.*, Sept., 1937) has relieved the sluice of much of the job formerly left to these simple but none too effective concentrators. On the other hand, the jig in turn is meeting stiff competition from new large-capacity reciprocating pan gold-catchers. These take little power, are easy to operate, and are reported to be efficient. They consist of relatively shallow pans or troughs mounted and reciprocated on a pipe shaft set parallel with the sides and bottom of the trough and passing through the ends of the trough. The bottom of the pan is curved, or is of the form of three sides of an octagon. The distance to the bottom of the pan on a vertical plane is not quite equal at all points of intersection. In these machines the feed flows through the pan from side to side and not lengthwise. The sides are lined with amalgam plates.

The table more than earns its keep. Some of its fields are in the production of coarse-sand tailing, thereby reducing grinding costs; production of coarse-sand concentrate, thereby aiding and relieving flotation; as a scavenger following flotation; cleaning of dirty non-metallic flotation concentrates (as, for example, scheelite); and as a major process in the concentration of many non-sulphide ores. It is finding its new field in the interesting oil-agglomeration process. The Deister Concentrator Company (*E.&M.J.*, April, 1938, p. 87) has brought out a new table for use in the ball mill-classifier circuit in competition with unit cells and jigs.

Heavy Liquids—Sink-and-float separation (*E.&M.J.*, May, 1938) commands new attention. For coal, and also for some other low-gravity minerals, the relatively cheap halogenated hydrocarbons have interesting possibilities. The success claimed for the process was due to the discovery of "active agents"—namely surface active substances which immunize the solids against the "parting liquids."

Heavy Suspensions—High-gravity suspensions as "parting media" in dressing minerals have had extensive study. Heavy-density cones have been introduced for concentrating zinc ores at the Mascot mine, in Tennessee. As the heavy medium, a pulp of finely ground galena has been used. The process is also being tried at the central mill of the Eagle-Picher Mining & Smelting Company, Picher, Okla.

Centrifugal Machines—Judging by the large number of patents being issued yearly on centrifugal separators, machines, filters, and similar apparatus, many must still think this is a field of potent possibilities. Centrifugal machines in ore dressing, in one form or other, have not met with extended application.

Electrostatic Separation—Interest in this process has been renewed (A.I.M.E. T. P. 877, also *E.&M.J.*, Sept., Oct., Dec., 1938). Fundamentals have been receiving renewed attention and improvements in methods have been developed. One new development (*E.&M.J.*, p. 93, Jan., 1938) is that of the use of a gas-tube electrode to overcome the difficulty of particles sticking to the opposing stationary electrode.

Another interesting factor affecting the behavior of certain particles to electrostatic action is the nature of the particle surface. Etching of particles by acids and the deposition of foreign substances on the surface make them respond more readily to the static charge. The dryness of the surface and temperature are other important factors.

Flotation—Flotation marches on. The pressure of competition in the field of equipment is bringing about constant engineering improvements and some radically new flotation machines are now undergoing trial which threaten to force some of the older standard ones to look to their laurels. Large-volume units, in which much of the cell's cubic content serves, it would seem, as a reservoir, are drawing attention.

Controlling fineness in the preparation of minerals for flotation is a question of interest to flotation operators generally. It is definitely best accomplished (W. Gründer, Zeitschrift, V. D. I., 1937, 98-103) by employing sieves in the grinding circuit instead of the usual mechanical classifier. That this method of preparing flotation feed, however, is not likely to lead to improved metallurgical results in the cases of complex ores, in which middling destruction must receive prime consideration, is shown by W. M. Stephen (A.I.M.E., T.P. 901, 1938) at the mill of the International Nickel Company, Copper Cliff, Ont.

In non-sulphide mineral flotation, in cases where the middling problem is not present but where the fines portion of the feed is likely to give trouble, the possible advantage of the sieve in the circuit in lieu of the classifier is not to be overlooked. Fineness, in the preparation of minerals for flotation, however, may be controlled by stage grinding, with flotation sandwiched between the stages. This is not a new practice but the possible economies of this technique are not widely appreciated.

The question of the effect of pulp dilution on flotation results (Joseph Newton and A. C. Ipsen, *E.&M.J.*, 139, 42-45, May, 1938) seems to have been reduced to the fact that pulp density in itself has little or no effect on recovery, speed of flotation, ratio of concentration, or grade of concentrate, and that high pulp density aggravates the harmful effects of slimes.

Ore Dressing

Flotation in the usual manner, followed by decantation of the pulp, then by a second stage of flotation of the sand in new water, often gives results, both with sulphides and non-sulphides, much better than the single-stage process.

Search for reagents to effect frothing, mineral-wetting, and oiling for all kinds of mineral combinations goes on unabated. What were once thought to be separation problems impossible of solution are now falling under the chemical mechanics of the organic chemist. The cation active reagents are finding increasing utility in the flotation of quartz and various silicates. They are used most effectively now for making separations of quartz and silicate minerals from non-sulphide minerals. Selective flotation of quartz and silicate minerals has given promising results on several ores, but there is need for further development of new addition agents for use with these cationic oilers.

The separation of sylvinite from polyhalites by flotation (U. S. Patent, 2,105,294-5) in which the medium is a saturated solution of the ore, or of one of its constituents, and a soap, is a most interesting process. Oxidized ores are floated with mercaptan (Russ 44, 886) in solution of an aromatic amine, such as o-toluidine, amiline or xylidine. Copper sulphide is floated from molybdenite (U.S. 2,095,967 and 2,070,076) by inhibiting the flotation of molybdenite with a dye such as amiline blue or congo red, or with an organic protective colloid such as an aqueous starch-NaOH preparation. Oxidized antimony ore containing Sb 6.3 (24.4 per cent oxidized) and Fe 1.6 per cent in a gangue of quartz, limestone, and slate, is floated (Gorno-obogatitel. Zhur. No. 1, 28, 34, 1937), after being conditioned with $Pb(NO_3)_2$ and $CuSO_4$ and sulphidized with Na_2S. The collector employed is butyl xanthate or slate tar.

Fine gold in placer sands is in most cases readily recovered with amyl, butyl, and ethyl xanthates and Aerofloat. Sometimes soda ash is helpful and at other times it is not essential.

In conjunction with methods capable of recovering the coarse gold, 90 to 95 per cent of the gold can be recovered.

The Government Gold Mining Areas (Transvaal) reduction plant deals with 8,000 tons of banket ore per day. Classified sand, formerly cyanided, is now floated and the tailing is cyanided. The flotation concentrate is ground and cyanided. Here, flotation essentially serves the same purpose as a classifier and is to cut out a fraction of the sand (pyritic sand) for selective grinding.

Recovery problems at the Alaska Juneau involving flotation and the methods used to solve them (R. A. Hall, *E.&M.J.*, Jan. 1938) are of interest. Here the rougher table middling containing $0.60 to $1 in gold is ground to minus-65 mesh and floated in accordance with standard practice. Carbon and pyrrhotite are dropped with a colloidal depressant. A tailing of $0.06 and a concentrate of better than $300 are made. To handle the relatively large volume of minus-100-mesh pulp, a large-capacity (volumetric capacity of 150 to 200 cu.ft. per cell) flotation machine occupying a minimum of floor space was developed.

A new concentration process, known as the "picking process," has been described (E. Bierbrauer. Berg-u. hüttenmann. Jahrb. Montan. Hochschule Loben 85, 204-208, 1937), embodying interesting applications of presumably old flotation principles. For example, a coarse-grained mixture of phosphorite and quartz was separated by treating it with a 1 per cent solution of sodium palmilate to which preferably 2 per cent petroleum, or another oil, is added. This mixture is placed on a bitumen or naphtha solid surface at normal temperature. The phosphorite grains stick to the mass, whereas the quartz grains do not, and drop off upon rotation of the surface. If ice is used, the quartz grains will stick and the phosphorite drops off.

Professor Taggart (A.I.M.E., T.P. 838, 1937) continues effectively to defend the chemical theory of flotation. He is not even willing to give ground to those who have held out against the purely chemical theory behind the apparent fact that certain minerals, such as graphite and sulphur, possess a so-called inherent floatability. It has been pointed out (Wark and Cox, *Jour. Phys. Chem.*, 39, 551, 1935) that these minerals are floated by xanthate, which fact is pointed to as evidence against the chemical theory of flotation on the ground that oiling in these cases is not the result of chemical reaction between the xanthate ion and the mineral. It is contended by Taggart, and experimental evidence is cited to prove, that with these minerals a collector of insoluble oily nature is necessary in order to obtain a water-repellent surface coating, and that the coating occurs because of solubility or a tendency theretowards of the mineral in the oil or oily substance.

There is nothing startingly new in reagents to report over a year ago. In non-sulphide flotation, the reader should not overlook the excellent contribution of Oliver C. Ralston ("Flotation and Agglomerate Concentration of Nonmetallic Minerals," Bur. of Min. R.I. 3397).

Lake Ore Beneficiation Makes Progress

Study of Iron Country problems is pressed. Heavy-medium separation, jigging, magnetic concentration continue to receive attention

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ALTHOUGH requirements for iron ore in 1938 were considerably lower than in 1937, research and development in beneficiation work were carried on steadily, apparently with expectation of better years to come. As in past years, the greatest amount of work in advancing the cause of iron-ore beneficiation was done by companies having limited or non-existent reserves of direct-shipping or easily concentrated ores.

In its broader aspects, beneficiation of iron ores consists of improving the structure of merchantable material to make a more suitable feed to the blast furnaces, and the concentration of crude ore which is too low in grade for economical smelting. Greater attention has been given to the latter, and principally in the direction of efficient and economical elimination of silica. This phase of beneficiation has seen its greatest development on the Mesabi. In its earlier stages, concentration was limited to those ores in which the gangue occurred in fine sizes, so that simple screening of the crude ore, and further treatment of the finer material in log washers and classifiers, produced a total concentrate of shipping grade. In recent years, more attention has been given to ores in which gangue occurs in all sizes, and which generally require considerable crushing before treatment. At present there are five concentrators on the Mesabi Range and one concentrator on the Cuyuna having jigs to take care of such material as is encountered. There can be little doubt that at other properties additional material of like sort will be met, which will also require more elaborate concentrating equipment. It may be said that the trend is toward further utilization of such ores.

During the last two seasons, experimental work with a new concentrating process, so far as iron ore is concerned, attracted wide attention. This is the heavy-medium process, which uses a mechanical suspension of fine, heavy particles in water, together with a rising current, to separate ore from gangue. Fine galena was used as the medium in a commercial unit on the Cuyuna in 1937. Recovery of medium from the separated products was made by screens, settling tanks, tables, and flotation machines. Favorable concentrating results were obtained, but it was found that loss of medium was excessive, due to friability of the galena and the difficulty of recovering very fine particles so produced. Extensive experimental work indicated that ferrosilicon, having the composition of approximately 85 per cent iron and 15 per cent silicon, would be more suitable. Ferrosilicon is hard and magnetic, and has a specific gravity of about 7. In 1938, a pilot unit using it was installed and operated at a washing plant on the Mesabi. Recovery of medium from the separated products was effected by shaking screens, settling tanks, and magnetic separators. Loss of medium is reported low and well within economic limits. Various ores from the three iron ranges of Minnesota, as well as jig tailings from Mesabi operations, were tested. The specific gravity of the medium was varied from about 2.80 to 3.30, in accordance with requirements of the different ores. Most of the test runs were made on material of minus 1¼ in. plus ¼ in. in size. The favorable results obtained have led to further experiments, now in progress, to extend the process to treatment of ores finer than ¼ in.

A plant in the western part of the Mesabi continued to test a four-cell, pneumatic jig, in which the bed is pulsated by compressed air which actuates the pneumatic tubes set below the screen in each jig cell. The principal object is said to be to discover whether any mechanical weaknesses existed, so that the design could be corrected.

A jig developed by Nordberg to treat fine ores was tested on the Mesabi. The feed was a minus ¼-in., low-grade, bowl-classifier rake-product. The jig has three cells and features a shallow, pulsating hutch, the latter made possible by a rubber diaphragm. Concentrates made above the screen are drawn off along the whole width of the jig by means of star gates actuated by motors propelled by oil under pressure. The gates can be individually revolved at speeds of from 0 to 10 r.p.m., and adjustments can be made while the jig is in operation. Two such jigs, each having two cells, were installed during the season in a Cuyuna plant.

Another Nordberg product, the Auto-Vortex classifier, was tried at a plant on the Mesabi. This was a small, 3-ft. diameter machine. Tests were made on portions of bowl classifier feed and overflow. The Nordberg machine features an automatic discharge of concentrates from the bottom of the classifying cone, the amount of discharge being controlled by the weight of material in the cone. The classifier is used commercially in sand washing.

Interest continues in the possibilities of improving concentration through the use of heavy-density jig beds by treating deslimed but unsized feed, and by recirculation of ground middlings. Considerable work of this nature has been done and more is planned.

In an effort to reduce costs, the magnetic roasting plant at Cooley used producer gas instead of distillate for fuel in the reduction of hematite to magnetite. Some experimental work has been done at this plant to make sponge iron from fine concentrates. The Minnesota Mines Experiment Station and a private organization are jointly interested.

More thought is being given to the subject of magnetic concentration of natural iron ores. As yet the work is in the laboratory stage, but attention is being called to the fact that the ores have varying degrees of magnetic permeability, and that some ores can be concentrated by powerful magnets. Some engineers look for further developments, possibly leading to use of high-intensity magnetic separators.

On the Mesabi there is a considerable tonnage of sludge basin material consisting of fine tailings from washing plants. About the points where the tailings launders discharge, varying amounts of concentration take place, in fan-shaped areas, the leanest and finest particles in the tailings being carried farthest from the points

of discharge. Some work has been done in an effort to utilize the more enriched portions of such tailings. This involves further concentration of the material in the mill and sintering of the resulting fine concentrate, unless it can be absorbed by mixing with sufficient coarse concentrate to meet the usual requirements of structure for total concentrate.

A trend is developing toward the utilization of coarse, rocky material which carries bands of ore. At most washing plants, all material coarser than 6 in. is discarded, though in a few plants only the leaner pieces are removed as waste and the rest is crushed and joins the undersize mill feed. In some plants, rock smaller than 6 in. is either hand-picked or else all minus 6 in. plus 3½ in. material is removed by screens. During the past season, one plant crushed minus 5½ in. plus 3½ in. material when it carried recoverable values, and wasted it when the rock was lean. A jaw crusher was installed in another plant to treat such intermediate-size material similarly. Ores are variable in other respects, and it is becoming generally recognized that concentrators should have flexibility to meet the needs of the different ores as they are met in the daily operations of the mine or mines serving them.

Some interest is being shown in trying to recover concentrates from rock of any size, and even when a considerable part of the values is disseminated and recoverable only after considerable grinding. It is generally felt that only the partly decomposed taconite which carries banded ore has economic possibilities at present.

Trommels appear to be giving way to shaker screens in new mills and those requiring replacements. Lower installation and maintenance costs and more efficient screening are given as the factors favoring shaker screens.

Laboratory work in the flotation of fine iron ore continues at the University of Minnesota, and some work of this nature is being done at the Michigan College of Mining and Technology. Flotation of iron ore in the Lake Superior district has not yet been brought to the pilot-mill stage.

The next event in the history of beneficiation in the Iron Country will probably be the adoption of the heavy-medium concentrating process. It seems clear that jigging has met a keen competitor, at least in the concentration of material coarser than ¼ in., and it remains to be seen what improvements the supporters of jigging can devise to meet this situation. It is possible, however, that the advantage may lie in the use of both processes, the jig serving as a rougher concentrator to produce grade ore without regard to grade of middlings and tailings, and the heavy-medium cone serving as a cleaner unit for the middlings and tailings.

Copper Metallurgy Improvements Limited

Curtailment or shutdowns during year minimize opportunities. Some new plants are built. Leaching at Ray. Some changes at Noranda

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MANY copper - producing plants were running on a curtailed basis or were entirely shut down for various periods of time during 1938, with the result that few radical improvements can be recorded.

The Outokumpu smelter, at Imatra, Finland, which uses an electric melting furnace instead of the conventional reverberatory, has entered its third year of operation. The flowsheet of its mill was improved by making a better separation of iron sulphides and chalcopyrite, so that it has been possible to reduce the quantity of copper concentrates sent to the smelter, and in turn to increase milling capacity without increasing that of the smelter.

A new copper-nickel smelter is to be designed and erected in northernmost Finland in 1939. It will consist of two large electric melting furnaces and two large converters.

The Boliden smelter, at Rönnskär, in Sweden, is now getting concentrates from the mill at the new mine at Laver, which started in February. This will increase the copper output. Another new mine, Kristineberg, 100 km. northwest of Boliden, is being developed. The ore contains copper and zinc. Concentrates will be produced by 1940. These two mines, situated remotely, have each been developed to a point where a new townsite and new roads must be built. Concentrates will be transported from them to Boliden by auto trucks and from Boliden to Rönnskär by rail. All this has necessitated doubling the capacity of the electrolytic refinery.

Owing to high freight rates Mount Morgan, Ltd., in Australia, is to build a small smelter to treat the copper-gold concentrates from its mill, whose capacity is being enlarged from 7,700 tons to 10,500 per week. Saving of £50,000 (Australian) per year is expected.

At the Murgul mine, Borcka, Province of Artvin, in Turkey, a new 2,000-ton copper concentrator and a 200-ton copper smelter will be built. This mine belonged formerly to the Caucasus Copper Company, and was operated until 1916. The smelter will have a reverberatory, with probably oil-firing and wet-charging.

Tennessee Copper's principal source of revenue is from sulphuric acid and iron, and consequently its copper metallurgy is passing through a slow process of change from the old method of smelting ore directly in blast furnaces to all-milling selective flotation. At present only one small blast furnace is in operation, to supply matte so as to convert the currently-made copper concentrates in the Peirce-Smith converter. In the near future the blast furnace will be replaced, probably with a coal-fired reverberatory or an electric furnace.

Nevada Consolidated's new Chino smelter at Hurley, N. M., is to go into operation early in 1939 at expiration of the present contract with El Paso smelter. In operation and design, it is patterned much after the same company's revamped McGill smelter, so well described in A.I.M.E. T. P. 981, February, 1938. The reverberatory is of the wet-charge type, the charge material being distributed along the furnace by vibrating conveyors. This practice of wet charging seems to be growing in importance as mills make higher-grade concentrates. By thus designing a smelter, it is possible practically to eliminate dust.

A super-duty fireclay brick is used at the front end of the arch with satisfactory results at the McGill smelter.

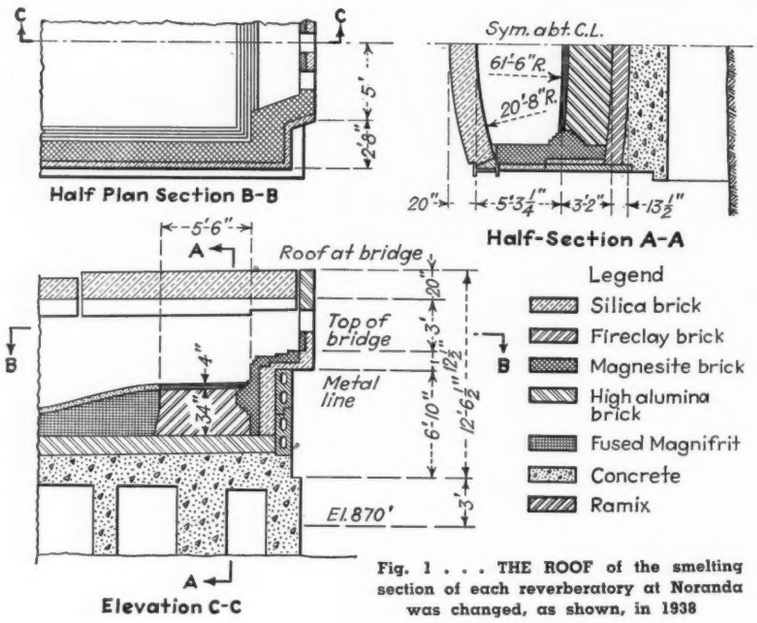

Fig. 1 . . . THE ROOF of the smelting section of each reverberatory at Noranda was changed, as shown, in 1938

At Lark, Utah, Ohio Copper is treating up to 1,600 tons of copper tailing per day, which are "hydraulicked" to the mill.

At the Phelps Dodge Douglas smelter the new waste-heat boiler has had a year of successful operation. Its operation as well as the power plant is described in A.I.M.E. T. P. 996 by L. L. McDaniel. The method of hot-patching the inside of silica arches of operating reverberatories has been adopted. This was developed by C. R. Kuzell, at Clarkdale.

Robert Thomas, general manager of Kennecott's Ray Mines Division, has developed and put into successful operation the leaching of copper from worked-out areas at Ray, Ariz.

From Flin Flon John Ambrose reports that the tonnages smelted by Hudson Bay were in excess of those of any previous year, due to satisfactory results obtained from changes made (and reported) in 1937. In October, 1,228 tons per day was smelted (the fuel ratio being between 2.8 million and 3 million B.t.u.'s per ton of solid charge) and some days considerably more, even exceeding 1,300 tons. However, smelting capacity was in excess of the feed. He attributes this increased tonnage to the side-burners and the enlarged cross-sectional area of the furnace. The magnesite suspended arch over the entire furnace, including nose tile at the uptake, has been a distinct success. Shutdowns for repairs have been limited to about one per year. Quoting Mr. Ambrose:

"Increased furnace tonnage provided more matte for the converters. The required blowing time increased to the point where the addition of custom concentrates direct to the converters delayed converter operations beyond the point where the converters could handle all the matte produced by the furnace. We found it more efficient to smelt all the concentrates in the furnace instead of trying to run the furnace on reduced tonnage and add surplus concentrates direct to the converters."

Blister copper production for the year averaged 118 tons per day.

At one Arizona smelter a big improvement has been made in the smelting practice by changing from oil to gas fuel, enlarging the verb area as well as the uptake area. There might be some question whether the increased tonnage can be attributed wholly to changing from oil to gas firing. Work at Noranda, where pulverized coal is used, has demonstrated that increased tonnage can be traced to increased uptake and flue areas, and by raising the roof of the reverberatory in the firing section, so that the cross-sectional area of the combustion part of the reverberatory is sufficient to burn the increased amount of fuel properly. The fuel was not changed at Noranda to increase the tonnage.

When S. R. Coghlan, assistant smelter superintendent at the Braden plant in Chile, visited Noranda, he reported that air pipes with venturi were used as vacuum dust cleaners around the smelter and such collected dust was discharged into the Cottrell. At Noranda, K. Williams enlarged upon this idea and suggested that the air pipe with venturi be used as a transporter of roaster Cottrell dust.

The Noranda roaster Cottrell has six chambers or units with screws under each, which formerly discharged the roaster dust into charge cars. Now, at the end of each screw casing, a hole has been cut in which a screen is placed. Below the screen a 4-ft. tank 7½ ft. high has been installed. Everything has been made dust tight. In the tank bottom there is a conical discharge connected to a 4x3-in. venturi using a 9/32-in. air nozzle connected to a 3-in. pipe. By easy curves each pipe rises 30 ft. and leads to a particular roaster and discharges the load of dust on the sixth or next to the lowest hearth, having the inside drop. In this way, the stream of dust will strike against the solid hearth above. There are nine roasters, six of them equipped for handling roaster Cottrell dust. Previous to installing this equipment about 225 tons of roaster Cottrell dust was fed daily and in bulk directly to the reverberatories. After over eight months of continuous use no noticeable circulating load has been built up in the roaster Cottrell system. By this method of handling the Cottrell dust, its temperature is raised and the dust is thoroughly mixed with the roaster calcines and is held by the coarser calcine particles so there is less sliding and dusting of the charge when fed to the reverberatories.

The calcine bins under the roaster at Noranda have been equipped with three pipes, two of which are to conduct the displaced dust-laden air from the calcine cars back through the roaster Cottrell system. The center pipe is for discharging the calcines to the calcine cars, which have three holes in the tops. This has resulted in the elimination of a great deal of the dust formerly escaping on the feed floor under the roasters.

The charge hoppers over the reverberatories have been entirely covered except for a 9-in. slot along the center. As the calcines run out of the cars into the feed hoppers, the displaced air is exhausted through pipes beneath the bin cover to West-

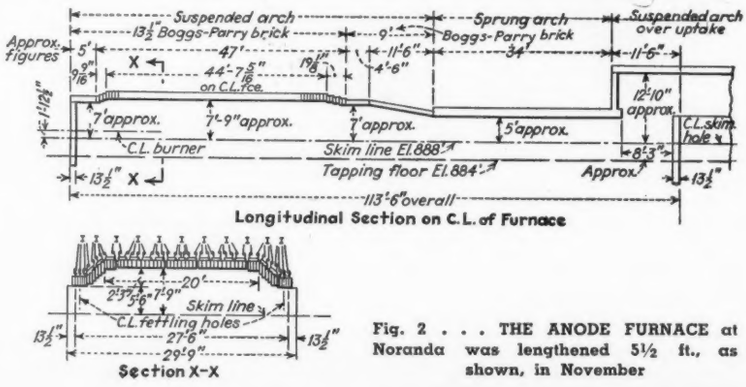

Fig. 2 . . . THE ANODE FURNACE at Noranda was lengthened 5½ ft., as shown, in November

ern Precipitation Multiclones, where 90 per cent of the dust is recovered.

These changes have eliminated a great deal of the dust on the feed floor and have increased appreciably the tons of charge smelted per furnace-day by about 125 tons per furnace.

Design of the roof of the smelting section of each reverberatory has been changed. Had it been made perfectly flat, it would have been necessary to raise the side walls. Had the side walls been raised, the charge, fed from the opposite sides of the furnace, would have met in the center and closed the open channel of liquid slag. To avoid these difficulties the side walls were left unchanged and the roof was extended flat to a point just inside of the drop holes, and from this point each row of brick was stepped up about 2½ in. for six courses (18 in. approximately), and then carried flat to meet the same construction coming from the other side of the furnace. This gives a flat arch about 20 ft. wide in the center of the furnace and about 45 ft. long. From the burner wall the brick are similarly raised to meet the flat arch. The end of the 45 ft. length of flat arch is gradually dropped in the same manner to the old roof level. Fig. 1 shows the details. The effect of these changes is to give a dome-shaped section of the furnace of increased cross-sectional area, allowing an additional amount of coal to be burned with a resultant higher tonnage of charge smelted. Present furnace tonnage is limited now by the capacity of the roasters.

Furnace tonnages during two consecutive months are tabulated below.

Each furnace has a suspended roof for 70 ft. from the firing wall, and the men have worked out a method of patching the suspended roof (by hanging in new brick) with full fires on, so that it is only necessary to shut down each reverberatory about once a year for 18 hours to repair the side walls, firing walls and uptakes.

In November, 1938, the anode furnace was too small to cast each day's production in one charge; consequently, it was lengthened 5½ ft. (Fig. 2). To save time a 13½-in. inverted fireclay arch was laid on the concrete foundation extension, followed by 38 in. of Ramix tamped in place. A 4-in. surface of magnifrit was then fused on top of the Ramix. Within two weeks part of the 4-in. fused surface came up, due, undoubtedly, to improper fusion, but it has caused no trouble after six weeks of operation.

Noranda Furnace Tonnages

	No. 1 Furnace 1938		No. 2 Furnace 1938	
	June	July	June	July
Tons of solid charge	45,047	46,492	45,059	46,599
Furnace days	29.98	30.98	29.81	30.98
Solid charge per fce. day (tons)	1,507	1,501	1,512	1,504
Fuel ratio*	9.9	9.8	10.2	10.3
Total N.M.B.M. smelted including converter siliceous ores (tons)	110,097	113,220		

* Wet coal (containing 3½% moisture) as weighed on receipt.

Lead Smelting Practice Advances

Trend is toward larger units. Adoption of wider sintering machines continues. Increased blast-furnace capacity is an objective

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THE principal advances recorded in the metallurgy of lead during 1938 continued as gradual developments in previous practice. The trend toward larger smelting units was most noticeable in the use of larger sintering machines. Those who in recent years have installed larger blast furnaces of changed design have continued to run them successfully. Plants making sulphur from waste gases have continued to smooth operations; experimental work has been largely confined to making richer SO_2 gases and to developing absorbents. Additional byproducts were made. In general, however, decrease in lead sales from 1937 levels, combined with labor adjustments, has not encouraged expansion in plant capacity in the United States, although the world production for 1938 will be large. In many instances, however, operators have taken advantage of slackened pressure on production to renovate their physical equipment.

Feed to Smelters—Large concentrators handling lead ores have in instances improved recovery and also made richer concentrates. Thus, the percentage of lead and silver recovered by the Zinc Corporation in the lead concentrates made from Broken Hill ore increased in the last four years from 94.5 to 96.5 per cent for lead and from 90.8 to 93.4 per cent for silver. (Zinc recovery in the zinc concentrate increased from 80.2 to 85.9.) Many smelters continue to receive richer lead concentrates than they can desulphurize by sintering without adding diluents. If lower-grade lead ores, byproducts, or ores containing precious metals are not available, barren material must still be added. At other concentrators it has been found that their lead minerals are more closely associated with and difficult to separate from other minerals, zinc blende in particular. Thus, where the attempt has been made to float some old tailings (for instance, the reground rejects from old gravity plants), it has been found difficult to make high-grade lead concentrates. The continued high price of gold also makes available many precious-metal ores containing but little lead. The copper smelter with its lower smelting rates, however, is a strong competitor for such feed, and during the year under review has even taken some feed from cyanide plants. The lead smelter erected at Wiluna, Western Australia, to smelt gold concentrate formerly roasted and cyanided, seemingly has been awaiting development of new ore; apparently a slurry of concentrates and residues will be sintered in a rotary kiln to make a clinker to be fed to the blast furnace.

Sintering—It appears that the idea of increasing the size of nearly all smelting apparatus will be most widely adopted for sintering machines. At Port Pirie, South Australia, machines now have two 10x10-ft. wind boxes. During 1938 machines 63 in. wide were approved for Selby by the American

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Lead Smelting

Smelting & Refining Company, in addition to those now at Chihuahua and San Luis Potosí (Mexico) and at El Paso. (The machines at Leadville were made longer.) It also seems likely that the wider machines will be adopted for the "first over" operation, as well as for the second.

Quality of sinter made on the wide machines is excellent, and so is their capacity: 1,200 tons of finished sinter per 24 hours is reported for the 10-ft.-wide machines for the "second over" at Port Pirie.

The large percentage of the total volume of gas that is "false" (air that has leaked through the side of the pallets, etc., without combining with sulphur) with the narrower (say 42-in.) machines has been brought out strikingly by the wider machines. Some of the wide machines now handle only half as much gas per ton of sinter. The wider machines then apparently will give richer SO_2 gas for those wishing to utilize it and less gas from which to collect dust. However, data obtained from experimental work at United States plants, and comparisons of the strengths of SO_2 gas obtaining under the pallets vs. concentrations at the fars, show that the rate of burning of cakes, their porosity, and the drafts used all have a powerful influence upon the leakage of air and upon the strength of the SO_2 gas made. Mechanism for sealing against air leakage, etc., also governs the concentration of SO_2. It then would be advisable to await complete, authoritative data from company metallurgists before attempting to credit the saving in volume of gases to be handled from wider machines too closely to one factor.

In many plants, by far the greater portion of the "sulphide sulphur" as well as of the lead (the fuel as well as the metal) arrives at the smelter as rich lead flotation concentrates. It is difficult to exaggerate the importance of intermixing the lead concentrates thoroughly with the other constituents of the sinter charge. At Helena, a new system for weighing and proportioning the ingredients of the charge more accurately was installed in an inclosed steel and concrete building. To this mixing and proportioning system, the smelter attributes no little portion of its success in roasting charges containing up to 75 per cent of zinc-plant residue, although, of course, more coke is needed as fuel and there is no attempt to utilize the SO_2 gases evolved (15 per cent residue was thought the limit some years before).

Many smelting plants that have been constructed for some years are now operating one or two blast furnaces out of perhaps three or six, and their furnaces in use are not operated continuously. The sintering equipment, on the other hand, is being operated nearly at capacity and a "100-per cent sinter" charge is aimed at where some years ago 15 or 20 per cent of sinter was usual. As a rule the sinter made is better desulphurized, coke breeze is more commonly used to supply fuel and also to give more strength to the sinter by reduction (forming ferrous silicates, metallic lead, etc.), and although considerable of the final sinter is of nut or pea size, little of it will form dust. Sinter cakes containing only 35 or 38 per cent of lead may form enough metallic lead in the wind boxes to make it advisable to use "dividers" there to diminish the size of the lead cakes that must be removed. The feed to the lead blast furnace is then being "predigested" and prereduced to an increasing extent on the sintering machines, contributing toward increasing the furnace capacity.

Blast Furnace Operation

Describing the Trail plant, J. B. Huttl (*E. & M. J.*, Vol. 139, p. 134, June, 1938), after mentioning the new blast furnace, 60x270 in. at the tuyère zone with 36 2¼-in. tuyères on each long side, attributes the increase of 30 to 50 per cent in blast-furnace capacity to thorough preparation of the sinter, wider shafts, more tuyères of smaller diameter, and to making slags with a higher lead content. The new furnace at Kellogg is of the same general type.

The still more radically modified blast furnace at Port Pirie, with an upper and a lower row of tuyères, is 17x4 ft. wide at the lower tuyères, the long sides being curved outward to 10 ft. wide at a plane 3 ft. above the tuyères. The upper set of tuyères at this plane is supplied with air at a lower pressure than at the lower tuyères. But few accretions form in the furnace, the CO from the coke is well utilized, and the capacity has increased from 275 to 475 long tons of sinter. J. C. Hughes attributed (*Proc.* Australian I.M.M., No. 107, 1937, page 176) most of the lost furnace operating time and many irregularities of operation to accretions in shafts of older furnaces.

The idea of lessening accretions by operating the jackets as hot as possible seems generally accepted. At least at some blast furnaces that must be shut down part of the week it has been found advantageous to circulate hot jacket water with a pump and to add cold "makeup" water to keep the temperature to 170° to 180° F.

The formula for increasing blast-furnace capacity adopted by some United States operators agrees with the low-sulphur, "predigested" sinter part of the specifications but recommends the use of scrap iron (4 or 5 per cent) and less coke (8.5 or 9.5 per cent). With a fast-running furnace, the composition of the slag can be adjusted to handle such otherwise objectionable constituents as zinc and still make reasonably "clean" slags. To make a rough comparison from one slag-forming ingredient alone, the capacity of some furnaces of standard size runs from 450 tons daily for a 36 per cent silica slag to 550 tons with a 26 per cent silica slag, and to over 600 tons for a furnace making a 22 per cent silica slag. Some even higher figures were given for one plant making a 24 per cent silica slag.

Drossing—Many of the smelters continue to remove the bulk of dross-forming impurities from their bullion and to remove the bulk of these before the bullion is sent to the refinery: some refineries specify rather definitely the permissible impurities that they will accept. At several plants, most of the arsenic is removed by roasting in hearth furnaces the products richest in arsenic, before sending them to the D. & L.'s of a lead plant, or to the copper reverberatory. The type of dross shipped by a given smelter depends most largely upon where it is desired to throw the precious metals, particularly the gold. The lead smelters without copper plants in general ship the impurities as a matte or a matte-speiss; those with their own copper plants may produce what is more nearly a speiss. No plants were noted that switched from fire to electrolytic methods of refining, or conversely. There are some indications that fire refining will be the cheaper operation in certain ranges of bismuth content—below a certain maximum, and where it is desired to refine to not too low a minimum content. Cerro de Pasco is reported to have added a pilot plant as a predecessor of a 100-ton electrolytic zinc plant.

Huttl mentioned (*E. & M. J.*, Vol. 139, p. 46, Nov. 1938) a daily capacity of 60 tons of elemental sulphur for the Trail sulphur-fixation plant. The Bureau of Mines published R. I. 3415 on the use of various aliphatic amines as absorbents for SO_2. It was reported that Trail will also market refined antimony.

On the continent of Europe, France, Germany, and Poland, with an excess capacity in lead smelters over ores available, sought ores from colonies, abroad, or Germany, respectively. France received ores from her colonies such as Tunis and Morocco, Germany imported and smelted ores amounting to about half of its lead production, and Poland lost most of its ore supply from Germany. New German plants are to be built at Mechernicke, near Aachen, to treat and smelt some 3,000 tons of low-grade material daily. Trepca, now one of the great lead producers, plans to smelt its own lead concentrates within Yugoslavia.

Zinc Metallurgy Is Far From Static

Basic changes lacking. Improvement sought in many directions. Expansion in foreign field. New electrolytic plants are planned abroad

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DEVELOPMENTS in zinc metallurgy during 1938 were largely adaptations of known processes to larger-scale production. In ore concentration, increased flotation efficiency has been supplemented by extended heavy-density separation. Suspension-type roasters have virtually supplanted the multiple hearths at Trail, B. C., and were tried in the United States. Recovery and utilization of byproducts, particularly sulphur dioxide, have been increasingly important. Smelters and electrolytic plants were meeting the demands for larger quantities of high-purity zinc.

Two-thirds of the zinc mined in the Western States, or only about 20 per cent of domestic production, is electrolytic; the rest is produced by high-temperature reduction and distillation by means of vertical or horizontal retorts or by electrothermic methods. About 40 per cent of the foreign production and 100 per cent of the Canadian output is electrolytic zinc.

Abundance of suitable fuel and limited hydro-electric power in the Eastern and Middle Western States have been factors favorable for the continued expansion and development of distillation processes. The uniformly clean high-grade concentrates obtainable from Tri-State ores insure a simplified smelting procedure. This is an additional factor that discourages a change to electrolytic zinc. But the western electrolytic plants, operating with low-grade concentrates from complex orebodies, with unfavorable freight rates, and frequently with unreliable or inadequate power supply, have met competition successfully and uniformly for twenty years.

Certainly, electrolytic zinc is believed to be cheap zinc and electrolytic producers have led in establishing supplies of metal of highest purity. It cannot yet be concluded that either distilled or electrolytic zinc has achieved maximum usefulness in the United States.

There was little active construction in plants of the United States and Canada in 1938. Zinc operations were curtailed during the year. The Eagle-Picher Lead Company at Picher, Okla., has installed and operated two heavy-density cones in an installation similar to the differential-density plant at Mascot, Tenn. The cones handle all of the coarse feed (about ½-in. and 1½-in.) to the regular concentrating plant, which is designed for a capacity of 10,000 tons per day. The coarse tailings are suitable for use as railroad ballast.

The Consolidated Mining & Smelting Company plant at Trail, B. C., has continued to improve the technique of suspension roasting. According to S. G. Blaylock, the suspension roasters were treating 110 to 140 tons of concentrates per roaster-day and giving excellent results as to low-sulphide sulphur and permitting high extraction. Reduction of moisture in the concentrates at the concentrator to about 5 per cent has assisted in maintaining uniform roaster operation.

Damp ore is fed to the top hearth of a converted seven-hearth Wedge roaster and is dried on two top hearths. It then discharges through the side to a ball mill for disintegration of agglomerates and is then elevated to a hopper above the furnace. The dried concentrates are then blown into the furnace at the top of the combustion chamber by means of air introduced by an auxiliary fan. The temperature in the combustion chamber is about 1,750 deg. F. About 60 per cent of the concentrate is dropped out directly and further reduced in sulphide sulphur on two more hearths. The gases may be used to assist in drying the incoming concentrates in the upper chambers or may be passed direct to the cyclone dust collectors. If desired, the quantity of sulphate sulphur can be increased by circulating gases high in SO_2 over a third hearth at the bottom of the furnace.

The gases, carrying 30 to 40 per cent of the furnace feed as dust and about 9 to 10 per cent of SO_2, leave at the bottom of the furnace and go to a water-tube boiler, then to a cyclone dust collector, which removes 85 to 95 per cent of the dust, and finally to a Cottrell treater, which removes 97 per cent of the remaining dust. Dust collected in the boiler, the cyclone, and the Cottrell treater is conveyed to the leaching division.

The Société Anonyme de Rothem announced the construction of a new roasting plant at Rothem, Belgium. Details are lacking, but it is understood that a primary object is to obtain maximum sulphur-dioxide concentration and recovery for use in a new sulphuric acid plant.

According to G. F. Weaton, of the St. Joseph Lead Company at Josephtown, Pa., an improvement has been made in the company's leaching plant handling Cottrell dusts and sinter-plant fume. A scrub tower was introduced between the dust precipitators and the contact acid plant. Dust collected in the tower is settled in a tank, the clear liquor passing through coolers and returning to the scrub tower. The concentrated liquid is drawn off and sent to the leach plant. This has solved the stream-pollution problem.

Development of the electrothermic furnace has been continued at the Josephtown plant, greater capacity being obtained largely through better charge sizing for the furnaces and more critical control of power and operating functions. Recovery averaged 13 tons of zinc per day, assaying 99.96 per cent from a single vacuum condenser developed locally.

No further expansion in the use of the vertical retort process was reported. The German smelter at Oker (Rammelsberg), controlled by the "Preussag" company, which operates with the "New Jersey" process, continued to enlarge its plant.

The operating plant at Munsterbusch, near Stolberg, Germany, extended its expansion program in 1938, and an idle plant at Nievenheim, belonging to the Stolberg Lead & Zinc Mining & Smelting Company has resumed and increased capacity. Pro-

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duction was increased by another modern plant, Berzelius, at Duisberg-Wanheim, which began operation in 1935 with a daily capacity of 16 metric tons of fine zinc. In addition to the increased smelter capacity, a greater metal production is favored by installing new processes for recovery of zinc from low-grade ores and waste minerals, notably pyrite deposits and pyrite cinder dumps at Meggen. Recovery potentialities from this hitherto neglected source are indicated by the fact that the large dumps of pyrite cinder at Sturzelberg, near Neuss, contain about 90,000 metric tons of zinc metal. The Wessen process, still under development, which makes possible the direct smelting of high zinc-iron pyrite in blast furnaces, is calculated to add to Germany's increasing domestic zinc supply.

The Wessen Process

The Hüttenwerke Siegerland A. G., controller of the Wessen process, has had a blast furnace for processing high zinc-iron ores and scrap metal to pig iron by that process, whereby zinc is produced as a byproduct; but is not yet ready to divulge details.

Though not controlling the Wessen process, the Metallgesellschaft A. G. is especially interested in new processes for utilizing iron-pyrite ores with a high zinc content, owing to its prominence in the German pyrite mining industry and its control of other processes for smelting pyrite and other iron ores containing zinc, lead, tin, and other volatilizable metals.

The American Zinc Company operated a Waelz kiln at St. Louis, Mo., for the treatment of zinc-plant residue, in 1938. The oxide from the kiln is returned to the sintering machines.

The Waelz process is being used in this country for the treatment of muffle residue for recovering of the remaining zinc. In other countries it is used on zinc ores, residues, calamine products, zinc-bearing metallurgical wastes, tin ores, and zinc-iron ores. In this process the feed is mixed with reduction fuel (coke breeze or anthracite fines) and fed, after preheating, into a rotating kiln similar to a cement kiln. It is not necessary to fire the kiln continually, but usually arrangements are such that additional heat may be added if desired. In the kiln the zinc is reduced and volatilized, then oxidized in the vapor phase to the oxide, which is carried out by the gases and collected in baghouses or by electrostatic precipitation. This oxide may be recharged to retorts or may be used as feed to electrolytic plants. As a rule, the fume is not suitable for use as the oxide and usually is treated further for recovery of contained metals.

The Athletic Mining & Smelting Company at Fort Smith, Ark., installed in 1938 an electrostatic precipitator to handle sintering plant fume. The roasting is conducted on Ropp roasters and the sintering and final roast on Dwight-Lloyd machines. Sulphur removal and extraction of zinc are excellent.

Many plants have effected a longer operating cycle in view of the market situation, with consequent improvement in extraction and longer retort life.

In line with the German expansion program, the Madgeburg electrolytic zinc plant of the Georg von Giesche's Erben Mining Company, in Upper Silesia, was enlarged to a capacity of 60,000 tons per year.

No important changes were made in the flowsheet of the Trail, B. C., electrolytic plant. Filter aids, such as diatomite, are being used to lengthen canvas life and increase filtering rate. A study of electrolytic zinc deposits has shown that the structure is affected materially by the composition of the anode. The presence of certain elements in solution has similar effects. Melting characteristics are a function of the cathode structure. A process for making electrolytic zinc dust has been developed. This is on a semi-plant scale.

It is interesting to observe that American and Canadian zinc plants are dispensing with lead, sulphur, and rubber-lined cells in favor of "Prodorite" cells or tanks. Prodorite has been used in Europe for some time for acid-proof tile and sewer pipe. Its development for large castings such as electrolytic tanks was pioneered at Trail, B. C. Briefly, the casting plant consists of a stone heater, Prodorite pitch-melting pot, a mixing box, and a steel tank mold. The composition of tanks as cast is: Prodorite pitch, 7.7 per cent; asphalt, melting point 220 deg. F., 2.6 per cent; quartz flour, 18 per cent; quartz sand, 31.7 per cent; quartz pea gravel, 40 per cent; plus steel reinforcing wire.

The Norske Zinkkompani A/S. Eitrheim, Pr. Odda, has developed a new method of handling leach residue. The residues or tailings are pressed with coke breeze to briquets and worked with fluxes in a tunnel furnace to a matte containing copper, silver, gold, and a metal sludge containing zinc, lead and cadmium. The sludge, after calcining, is leached and filtered.

New zinc plants proposed during 1938 have been all electrolytic. Probably the most important is that of the Trepca Mines, Ltd., in Yugoslavia. By absorbing Kapaonik, already a producer, Zletovo, and Novo Brdo, about to start production, Trepca will become one of the world's larger lead and zinc producers. With State-granted special relief regarding current control, rates of exchange, and taxation for fifteen years, Trepca is to build a large lead smelter and an electrolytic zinc refinery having an annual capacity of 60,000 tons. The zinc plant is to be near Sabac.

A small electrolytic zinc plant is planned in Roumania by the State Mining & Metallurgical Enterprise of Ardeal, Transylvania. Cerro de Pasco, at Lima, Peru, is considering a zinc plant, to be completed in two years. Initial production is to be 100 tons of zinc per day. Construction will begin as soon as operating details have been worked out.

The Minister of Mines of Quebec has suggested the possibility of constructing an electrolytic zinc plant in Quebec.

Construction of new plants in Yugoslavia, Roumania, Peru, and eastern Canada would affect the zinc smelters in western Europe and England, because they depend largely on imported concentrates.

Pyrogalvanizing has been the subject of research. It is reported that preheating the articles to be galvanized, together with the addition of a small amount of aluminum to the zinc bath, is instrumental in reducing the tendency to form brittle iron-zinc alloy at the interface. Other attempts to reduce the thickness of the brittle layer were also made by using separating metals, by nitriding, and by carburizing. For prolonging the life of a galvanized coating, passivation of the surface and painting were investigated.

Zinc ammonium chloride has largely replaced sal ammoniac (ammonium chloride) as a flux in the plating bath, and for lathering, saponin and soap solutions have been substituted for glycerin tallow.

Electrogalvanizing

Electrogalvanizing was more firmly established. At the last meeting of the American Zinc Institute (April, 1938), E. H. Lyons, Jr., described a method of electrogalvanizing, using soluble zinc anodes, with particular reference to certain steel shapes that were not suitable for hot galvanizing. Current densities of 2,000 amp. per square foot were used to obtain uniform, smooth, and ductile zinc coatings of any desired thickness.

Increasing attention is being given to the production of bright zinc coatings, and several patents have been issued covering processes for producing bright zinc primarily and as cover coats following galvanizing by electrolysis or dipping.

American Zinc, Lead & Smelting Company announced a new process for the manufacture of pure zinc sulphide pigment. A plant has been working on the process and is large enough to permit the introduction of the so-called "white jack" to consumers for large-scale factory tests.

Electrometallurgy A Widening Field

Aluminum receives the spotlight. Power ample for zinc production. Pure manganese metal from sulphate solution draws renewed attention

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IN THE ALUMINUM FIELD, high-grade bauxite remains the most sought-for and used raw material amid continuing efforts in various countries to substitute lower-grade domestic ores of several types. In the United States the Alcoa, Tenn., and Massena, N. Y., plants made metal largely from high-grade ore. Mercury arc rectifiers, installed at both plants, are said to have met operating demands well, after a year's service. Ten 5,500-kw. double-tank, grid-control units were installed at Alcoa and five at Massena. The d.c. voltage to the cells is about 600. The Alcoa installation has all indoors equipment on one floor, yields 6 kw. per square foot of floor area, and has a 6-ton service crane. Less floor space, less headroom, smaller crane, and lower over-all operating costs are some of the results. The Consolidated Mining & Smelting Company pioneered the use of this type and size of conversion equipment for electrolytic purposes in America.

Abroad, the capacity of the Lochaber plant capacity of the British Aluminium Company was doubled by an expansion completed early in the year. A new plant in Wales was proposed by a Swiss company. Red sludge has been marketed to some extent.

Germany will come close to leading the world in aluminum production figures for 1938, yet she produces little of the ore she uses, the bulk being imported from Hungary and Yugoslavia. Austrian metal production was a few thousand tons. Capacity of the Rheinfelden plant, Germany's largest, was increased to 23,000 metric tons of metal per year. A refining plant at the Lauta Works for producing 99.9 per cent metal was being built in September. France ordered all bauxite shipments to Germany stopped.

The production of 40,000 tons of metal planned in Italy would require about 10 per cent of national power consumption. However, Italy suffered a prolonged drought, which interfered with plans for the year's electrometallurgical production, notably aluminum and zinc. The plant at Aurelia, near Civitavecchia, built to produce aluminum from leucite ore, is said to have changed to Istrian bauxite.

Two plants were proposed for Holland, but an easier metal market may have a bearing. Surinam (Dutch Guiana) and the Netherlands Indies both produce high-grade bauxite.

The U.S.S.R. continued work, without substantial success, on clays, leucites, alumites, and nephelines. Discovery of bauxite on the east slope of the Urals, considered better than the Tikhvin bauxite, resulted in plans for using it wherever possible. The Volkhov plant, near Leningrad, was expected to produce 12,000 metric tons of metal in 1938. Production cost has been estimated at 2,100 roubles per metric ton. The Dnieper plant was scheduled for 38,000 tons. Costs are supposed to be of the same order as at Volkhov. The new plant at Kaminsk, near Sverdlovsk, was built for initial production of 25,000 tons metal per year, 70,000 tons alumina from Ural bauxite, and 15,000 tons carbon paste. The total cost of the project, probably including that of the townsite usual in U.S.S.R. plans, is estimated at 98 million roubles. A reported plan is to supply Volkhov (1,200 miles) and Dnieper (1,500 miles) with Kaminsk alumina. The initial capacity of the Sosnovetz plant, Karelia, is given as 1,000 tons metal per year from Khibinogorsk (apatite plant) nepheline tails. Estimated cost is 36 million roubles.

Japan based early developments on raw materials other than bauxite, of which she is reported to have no deposits of note. And again it has been found such operations are not economically sound to date. Operating estimates, using alunite ore, have been given as 1,500 yen per metric ton of metal, against 800 yen when using high-grade bauxite. A plant in Manchoukuo was slated to begin production in 1938 and scheduled for 20,000 tons per year by 1941. At that time four plants in Japan and one plant in Taiwan are supposed to reach a total production of 77,000 tons per year.

Fink and de Marchi reported a method of treating ferruginous bauxite. The ore is treated with an excess of sulphur below the sintering point, selectivity converting the iron to ferrous sulphide and boiling off the excess sulphur. The sulphided product chlorinates easily and at low temperature compared to untreated ore. At 600 deg. C. the reaction is reported complete in the first five minutes of chlorination with removal of 90 per cent of the iron (29 per cent Fe_2O_3 bauxite), 50 per cent TiO_2, 14 per cent SiO_2, and loss of 9 per cent of the aluminum content.

Antimony—Trail reports completion of the 4-ton electrolytic plant and that breaking-in operations are proceeding normally.

Cadmium—The cadmium tariff was cut from 15¢. to 8¢. per pound in the recent treaty with Canada. Average purity of cadmium produced by Trail during 1937 was given as 99.968 per cent.

Copper—Outokumpu, Finland, is carrying forward plans for an electrolytic refinery.

German copper requirements continue to run far ahead of production, and strenuous efforts are being made to increase the latter from domestic low-grade ores with subsidies. The new electrolytic plant at Hettstedt, refining copper from the old Mansfeld deposits, started early in 1938.

A 2,000-ton per day concentrator, 200-ton smelter, and hydro-electric plant have been contracted for at Murgul Maden, near Boreka, Artvin province, Turkey. The mine formerly belonged to the Caucasus Copper Company. Production is scheduled for 1940.

The electric furnace used by International Nickel Company for final casting in its Canadian plant has met the test of extended operation, and a second similar installation is reported under way.

Indium—This metal was produced

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Industrial Minerals Grow in Importance

Non-metallics producers give increasing thought to beneficiation. Relative number of underground mines is larger. Florida phosphate reserves up

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COMMERCE in the industrial or non-metallic minerals in 1938 followed more closely the path of general trade than has sometimes been the case. The first half of the year was characterized by extreme dullness. The third quarter witnessed increasing activity and the final period of 1938 was one of fairly satisfactory business. Industrial minerals, however, include over 70 different titles with hundreds of diversified uses. It follows, therefore, that, while a statement such as the above may represent the broad cross-section of conditions, there exists within the industries wide variations of activity in individual cases.

In the absence of much building construction, a substantial part of business in cement, lime, crushed rock, sand, gravel, etc., has been due to Government spending projects such as dams, roads, etc. This is not, of course, uniformly distributed, much of it being confined to western and other areas near by the points of consumption.

Plant Construction.—New construction has continued at a low point except in the case of rockwool, for which nine new mills have been erected. Expansion has been discouraged by an unsympathetic attitude of the Government toward business, the uncertainty of the future with surplus and capital-gains tax laws, and the difficulty of providing new capital under these and other restrictive measures.

Beneficiation—Important technical developments have, however, continued. Until the last few years the non-metallic producers have been slow to adopt methods of beneficiation used in the metal industries. Intensive study of the flotation of non-metallics has been made by both private and Government groups. Where successful its application has resulted in profound economic changes in those fields. Efficiency of recovery and cost reduction have changed supposedly worthless material into huge reserves. This development, outstanding in the case of phosphate and cement materials, is likely to be extended to various other fields. Substantial progress has already been made in limestone, magnesite, potash, manganese ores, and fluorspar.

Another outstanding development is in the agglomeration method of separation. This process, which it is claimed may be successful on fragments as large as 1½ in., involves coating with a film of reagent of water-resistant properties, and then oiling. The oiled particles are then agglomerated, the separation being accomplished by tabling, the agglomerates being discharged over the tailing side of the table regardless of specific gravity. This method is in operation at Keene, N. H., at a quartz-feldspar mine, and is reported to yield products with less than 2 per cent impurities.

Extensive research on the application of electrostatic separation to non-metallics has been conducted by the Ritter Products Corporation at Rochester, N. Y. Satisfactory results are claimed.

Mining—An increasing number of operations are adopting underground methods. This has been largely due to the exhaustion of easily reached surface deposits. Early development in many cases has been in the hands of men with little capital or technical training. With exhaustion of relatively high-grade, cheaply mined surface deposits, capital for mechanization is needed, and few of the primitive operations will ultimately survive competition with better equipped mines under skilled technical direction.

Block caving on a large scale is now used in some of the asbestos deposits at Thetford Mines, and most of the standard mining methods may now be found at various non-metallic operations. Introduction of belt conveyors to replace hoists is reported at the property of the Chemical Lime Company at Bellefonte, Pa.

Tariff Reduction—Under the Trade Agreement between the United States, Great Britain and Canada, substantial concessions in tariff rates have been granted by the United States. It is yet too early to forecast accurately how this will affect domestic production in all cases, but it is certain that the flow of Canadian minerals to this country will be stimulated in some instances. Products affected are listed in the accompanying table.

Asbestos—During the first nine months production from the Canadian mines fell 33 per cent. Production for 1938 is estimated at around 300,000 tons, or 75 per cent of that of 1937.

Baryte—Extensive use of baryte in refractories may result from work completed at Battelle Memorial Institute.

Bentonite—Research work at the Massachusetts Institute of Technology has resulted in a centrifuge product of bentonite which, made into films, may be used as a substitute for mica.

Cement Materials — During the twelve months ended Nov. 30, production increased 10.1 per cent and shipments 4.7 per cent against the similar period in 1937. At the close stocks had decreased 2 per cent, notwithstanding that operations averaged 46 per cent of installed capacity compared with 40.6 per cent in 1937. Only one new private plant in the United States was reported. The largest development in recent years is said to be in Germany.

Duties on Industrial Minerals

	Duty	
	Old Rate	New Rate
Bentonite, unwrought	$1.50 ton	75¢ ton
Bentonite, wrought	$3.25 ton	$1.62½ ton
Cement	20%	10%
Chalk, precipitated	25%	15%
Clay, unwrought	$1.00 long ton	$1.00 long ton
Dolmite refractories	27½%	20%
Feldspar	35¢ ton	25¢ ton
Fuller's earth, unwrought	$1.50 long ton	$1.00 long ton
Fuller's earth wrought	$3.25 long ton	$2.00 long ton
Fluorspar (over 97% CaF_2)	$5.60 long ton	$4.20 long ton
Graphite, lump, drip, dust	30%	15%
Graphite, amorphous	10%	5%
Garnet products	20%	10%
Kaolin or china clay	$2.50 long ton	$1.75 long ton
Magnesium oxide or calcined magnesia	7¢ lb.	5¢ lb.
Magnesium carbonate precipitated	1½¢ lb.	.....
Mica, untrimmed, small pieces	15%	10%
Mica, waste and scrap	25%	15%
Mica, ground	20%	15%
Nepheline syenite	30%	15%
Salt, bulk	7¢ lb.	4¢ lb.
Talc, steatite	25%	17½%
Umbers, crude	1/8¢ lb.	1/16¢ lb.

The third plant to utilize flotation in preparation of raw materials has been built by Lone Star Portland Cement Company at Parma, Argentina. Two other plants at Valley Forge, Pa., and in South Africa employ this method.

Chromite—Interest has revived in the Pacific Coast chrome deposits, some of which, operated during the War, have been purchased by Eastern steel interests. Research has been conducted on beneficiation and briqueting.

Feldspar; Nepheline-Syenite — Increased imports from Canada appear probable in view of tariff reduction under the trade agreement. American producers are also likely to have increased competition from the nepheline-syenite in Methuen Township, Ontario, not only because of a reduction of tariff but because glass manufacturers are showing increasing preference for it as a substitute for feldspar. The raw material is shipped to Rochester, N. Y., for beneficiation. The New England Nepheline Company also treats this material at Keene, N. H.

Granules—A large plant has been erected at Bound Brook, N. J., by the Statso Milling Company to utilize near-by trap-rock deposits in the manufacture of colored granules, used in making "patented" roofing.

Kyanite—Celo Mines, Inc., at Burnsville, N. C., is operating under lease producing three grades of kyanite. Byproducts include substantial amounts of garnet, mica, and zircon. The second operation is conducted by Phosphate Recovery Corporation in Virginia. As yet, domestic kyanite has not been particularly successful in manufacture of super-refractories. Its chief use is in production of glass-furnace tank blocks. It is also sold for use in refractory cement and mortars.

Magnesite — Westvaco Chlorine Products Corporation was the only producer of magnesite in California in 1938. Aside from its mining operations at Gustine it also operates a plant at Newark, Calif., having a capacity of 60 tons per day of magnesium products recovered from salt-water bittern. Magnesium carbonate precipitated with lime yields an equivalent of magnesite used in making refractories and other magnesium products. Costs are said to be low enough to permit competition with dead-burned refractory magnesite from other Pacific Coast deposits.

The North Western Magnesite Company continues as the only operator in Washington. Three methods of beneficiating low-grade portions of the Chewelah, Wash., deposits have been under investigation. Although larger scale testing remains to be performed, results are regarded as promising.

Phosphate Rock—The outstanding development in this field has been the recent huge increase in reserves in the Florida region. The discovery that some of the Florida land-pebble deposits are underlain by large bodies of hard rock phosphate is too recent for estimating its effect on economics of production. In addition, large-scale use of flotation has made tremendous amounts of low-grade material available.

Reserves in Florida now are put at several billion tons. This will probably wipe out the Congressional plan to restrict exports for conservation.

The T.V.A. operations at Muscle Shoals are producing calcium metaphosphate containing 60 per cent or more phosphorus pentoxide, as compared to 16 per cent in superphosphate. The advantage expected to result from this high concentration appears now to have been largely cancelled by the reported discovery that the availability in this product of phosphorus for soil culture is about the same as of raw phosphate rock.

Potash — With increased output available from the New Mexico field, together with another operation in western Utah, as well as production from Searles Lake, Calif., the United States may now be considered self-sufficient in potash supply. Notwithstanding, about 50 per cent of American consumption is still imported. The Union Potash & Chemical Company has obtained three Government leases in the New Mexico field and is preparing to produce potassium sulphate. All production is in the form of chloride. Announcement is made of recent organization of the Potash Export Association, Inc., through which American producers will direct exports.

Sulphur—After years of operation in which the price of sulphur from Texas and Louisiana has remained unchanged, a reduction of $2 per ton was announced by producers. There is apparently a widespread trend toward the production of elemental sulphur from pyrite and other sulphide minerals, large plants having been erected in Canada, Italy, and elsewhere.

Talc—Increasing amounts of talc and pyrophyllite are being used in the chinaware industry, particularly in Pacific Coast plants. Pyrophyllite is also being used as a substitute for flint in making electrical porcelain.

Powder Metallurgy Solves Various Problems

Progress has been made in many directions

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THE QUESTION has been asked, What is the outstanding development in powder metallurgy in 1938? The answer which will probably not be disputed by anyone is that scientists and industry have become powder-metallurgy-conscious and that the heads of large corporations and research organizations have appropriated or allotted funds for the study of this branch of technology and of the many new applications that suggest themselves. Technical colleges have become interested, the Massachusetts Institute of Technology deserving the credit for being the first, to my knowledge, to establish a course in powder metallurgy in the curriculum of its metallurgical division.

Owing to the recession, 1938 has certainly not been a good business year, but few progressive firms have reduced their research budget. Some have rather pushed research, in the hope that new developments might lead them out of the depression. Powder metallurgy has had its fair share of this work, and the many problems that have been submitted to those in the field, and the number of patents applied for and granted here and abroad, indicate that the number of possible places where it can be applied successfully are steadily increasing.

Powder metallurgy should be looked upon as the art that allows the production of characteristics in metals and alloys and compounds not obtainable by orthodox procedure, not as the art that allows a given piece to be produced one-eighth or one-quarter of

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Electrometallurgy

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for a time electrolytically from electrolytic zinc plant residue, but further production depends on finding a market for it or its alloys.

Lead—Trail operated its electrolytic refinery at a little higher current density and current efficiency, using more careful control of electrolyte composition and cell temperatures.

Magnesium—Investigation continued on the production of magnesium in northwestern United States from magnesite deposits of that region. Bonneville and Grand Coulee would, of course, provide abundant power. The American Cyanamid Company is said to be continuing its plans for production by the electrothermal process.

German consumption has not come up to production capacity. Hence there has been a great effort to increase the use of this metal. The nation possesses ample supplies of raw material. I. G. Farbinindustrie produces metal mainly from what was the waste liquor from potash operations. Wintershall continues to use carnallite from its salt mines. Both electrolyze fused magnesium chloride. The two companies can produce over 10,000 metric tons per annum.

Magnesium Metal Corporation, subsidiary of the same three companies carrying ahead the aluminum production program in Australia, planned to start magnesium production in Swansea, Wales, before the end of 1938, using the electrothermal process. France continues producing and saying little.

Italy produced a few tons in 1937 and planned for 1,000 tons in 1938 in Sardinia. Dolomite is the raw material. To the calcined dolomite hydrochloric acid and other chlorides, such as barium, calcium, and potassium, are added. Magnesium chloride is electrolyzed in fused condition, as in other countries, and the metal raised to 99 per cent grade by further refining. Plant capacity is supposed to be finally raised to 3 tons per day. Another plant to produce 2,000 tons of metal per year is planned for Bolzano. Japan is reported as producing and planning extensive additions.

Manganese—The United States Bureau of Mines reported the results of its investigation into electrolytic production of manganese. Oxidized ores were given a reducing roast to obtain a high solubility in leach solution containing about 200 g./l. ammonium sulphate, 9 g./l. manganese sulphate and 44 g./l. sulphuric acid. The filtrate from the leach (25 g./l. manganese sulphate) was purified of the same impurities and to about the same degree as in electrolytic zinc practice. Lead anodes, and low-carbon steel-alloy cathodes containing 17 per cent chromium were used as electrodes. The cathode current density was about 18 amp. per square foot. The voltage, due in part to canvas diaphragms about the cathodes, was 4.0 volts, the current efficiency for 48-hour deposition averaged 50 per cent, and cell power consumption 3.6 kw.hr. per pound of manganese.

Nickel—Japan is reported as having completed a small nickel refinery near Tokyo to treat low-grade domestic ores and imports from New Caledonia and British Columbia.

Tin—Bright electrolytic plating, without subsequent polishing, is bringing promising results in the United States. The amount required for containers is reported to be under half that needed in hot-dipping.

Zinc—Electrolytic production in the United States was not limited by a shortage of hydro-electric power as in 1937. Anaconda started its plant late, bringing production up to 75 per cent of total company capacity. Sullivan Mining operated two of the three units of its Kellogg plant for four months and one unit the rest of the year. United States Smelting continues to ship its zinc concentrates to Anaconda, but takes back its zinc as metal and markets it.

Trail found that pre-drying the concentrates yielded a marked improvement in the flash roast or "burning" process. Coating cast lead anodes with a layer of electrolytically plated lead formed an anode whose use produced cathode zinc of lower lead content. Trail also found a close relationship between dross formation and crystalline structure of zinc cathodes.

Zinc is Germany's real "domestic" metal. Production from its own ores should be fairly close to consumption in 1938, and the Magdeburg electrolytic production should be about 60,000 metric tons, or, say, 30 per cent.

Belgium will probably have to make a larger tonnage of high-grade metal to hold her markets; the Baelen plant was a beginning and has done well. Italian production was hampered by drought in 1938, which continued well into the year—an unlooked-for setback in its plans to export a sizable tonnage.

Rhodesian Broken Hill Company plant was likewise hindered by drought. Production will, no doubt, be well below 1937's low figure of 15,500 short tons.

Cerro de Pasco announced its intention of building a 100-ton per day electrolytic plant to be completed in 1940. Electrolytic plants are being considered for Eastern Canada and Yugoslavia.

Electrogalvanizing firmly established its merits in the wire field, and work continues on commercial application to sheets. Bright zinc electrolytic plating continues active.

Powder Metallurgy

(*Continued from page* 85)

a cent cheaper. Most of the development work is directed accordingly. If incidentally an economic advantage can be demonstrated, so much the better.

During the year under review, progress has been made in many directions. It is not exaggeration to state that problems which but twelve months ago offered metallurgical, mechanical, or economical difficulties have either been definitely solved or are on the point of solution. The production of metal powders has kept step with the advancing knowledge of the influence of grain structure and grain assortment. Though heretofore "all through 100 mesh" or "all through 300 mesh" seemed to be satisfactory, today the industry figures in microns and assortments of particles of given micron sizes.

A healthy cooperation between the producers of powders and users has resulted in the development of equipment that will permit almost any specification to be met and yet not raise the price beyond the economic level. Presses, die material, and die construction have kept pace with the advancement of the art. Lessons have been learned and applied to make homogeneous compounds not merely from two or three components but from even six elements fully diffused. An instance of the application of such a compound may be found in the dental field.

The art of sintering, heat-treating, and quenching has advanced many a step. Atmospheres for heat-treating can now be chosen from a number of available ones to meet individual requirements. Temperatures and heat-treating packs have been studied with a view to reducing distortion in the compressed piece to a minimum. These studies have been remarkably successful and I have recently seen a number of delicate parts made by powder metallurgy where a distortion of so little as 1/10,000 of an inch would spell disaster.

Again, splendid cooperation between furnace builders and scientists and users is responsible for a number of improvements that have been effected in the art of powder metallurgy. Time of heat-treatment, consumption of gases, is reduced, and cooling and quenching become a continuing operation instead of following in separate steps.

All in all, 1938 can be looked upon as a year of satisfactory progress. In an industry that presents such wonderful possibilities, however, enough is left to be added in many years to come to today's knowledge of all the fields which enter into that of powder metallurgy.

High Lights of 1938 Equipment

Trend of deeper mining operations, together with new State and Federal legislation, forces metal miners to think more in terms of mechanization

H. C. Chellson
Assistant Editor

RESPONSIBILITIES of a mine executive have increased considerably during the last few years. In addition to his technological problems in deeper mining, or determining a successful method in treating a block of low-grade ore, or perhaps worrying about finding a faulted vein, he is aware that social and international trade objectives of State and Federal governments have injected higher costs into his flow of precious- and base-metal ores. Therefore, he is forced to analyze judiciously new technical methods, so operations can continue on a profitable basis, assuring his men continued employment in spite of higher taxes, lower tariffs on minerals and a host of laws welded to economic and political uncertainties that continually obscure his outlook.

During 1938, equipment manufacturers offered their aid to the mine operator and some of the devices which they suggested for his consideration are briefly described herewith:

Core Drilling—In diamond drilling, E. J. Longyear Company, Minneapolis, Minn., points out there is a growing use of electric-driven drills, and manufacturers are adapting their models for this type of power, particularly for underground use. Manufacturers are reported doing experimental work in designing light core drills for drilling holes for blasting purposes. Drill designs and driving mechanisms are supplying increased bit-rotating speeds. C. Kirk Hillman Company, Seattle, Wash., reports a new demountable drilling unit for airplane transport. The most outstanding device for drilling large holes was manufactured by the Lake Shore Engine Works on specifications supplied by Pickands, Mather & Company for drilling a 5½-ft. diameter ventilation shaft to a depth of 200 ft. at the company's Zenith iron mine, in Minnesota. (*E.&M.J.* Oct. 1938)

Rock Drills—New drills brought out by the Ingersoll-Rand Company, Phillipsburg, N. J., were the JA-35 lightweight jackhammer, weighing around 35 lb., light enough for cutting hitches and other general mine use. A new hand-rotated Stopehamer, the SA-90, with throttle valve of unique design, was also announced by the company. Chicago Pneumatic Tool Company, New York, N. Y., announced refinements in the Autodrifters and in the company's 2-in. wet and dry CP-52 for heavy-duty sinking purposes. Gardner-Denver Company, Quincy, Ill., added to its line of motor-feed drifting drills, the AF-89 and AF-99 having 3½-in. and 4-in. bore respectively. Holman Bros., Ltd., Camborne, England, brought out their "Golden Arrow" stoper of 3-in. bore, weighing 121 lb. A stoper designed to take the burden of drilling from the hands of the operator and put it on a rod was announced late in 1938 by Sullivan Machinery Company, Claremont, N. H. Known as the S-10 "Safe-T-Stoper," it supports itself while drilling and while retracing and changing steels.

Of particular interest to the industry will be the results obtained in a survey during 1938 by *Engineering and Mining Journal*, relative to the use of detachable rock-drilling bits versus solid steel. Replies received indicate 44 per cent use detachable bits exclusively, 37 per cent use forged steel exclusively, and 19 per cent use both. Among those responding 55 per cent foresee the increased use of detachable bits at the properties represented, whereas 45 per cent do not expect any increase, having tried them and found them impractical. A glaring revelation in the survey was the apparent lack of any accurate system of records kept by operators for total drilling costs.

For resharpening detachable bits, the Mine & Smelter Supply Company, Denver, Colo., announced its Massco Junior rock bit grinder. For the user of a limited number of drill bits, the Gardner-Denver Company brought out a bit grinder on which an average of 100 bits per hour can be handled by two operators. Ingersoll-Rand Company announced a thread-forging device for I-R jack rods, eliminating the practice of annealing machine threads. In the field of rock-drill lubrication, E. F. Houghton & Company, Philadelphia, Pa., announced its line of Sta-Put lubricants.

Compressors—A heavy-duty diesel-engine-driven compressor known as the "XVO" was announced by Ingersoll-Rand. The unit is new in design and comparatively of light weight. Chicago-Pneumatic Tool Company, New York, reported improved cylinder design and a redesigned Simplate valve in its line of stationary compressors.

Explosives — Atlas Powder Company, Wilmington, Del., has a new galvanometer for testing blasting caps and electric circuits against moisture. The company also brought out Manasite detonators that are said to afford users greater safety.

Mine Car Loaders—Increased use of mine car loaders or "mucking machines" is noted each year in metal mines. This trend toward underground mechanization is materially reducing costs at many properties, and mine operators are aware that drifting operations are rapidly developing a "streamlined" technique. During 1938 the Sullivan Machinery Company, Claremont, N. H., announced its new line of mine car loaders. The units have a centering device which operates independently of the rocker-arm loading action. The Eimco Corporation, Salt Lake City, Utah, announced a new modification of the Eimco-Finlay loader, which is operated by a gasoline engine and runs on rubber-tired wheels without tracks. Gardner-Denver Company, Quincy, Ill., announced three mine-car loaders specified as GD-9, GD-9H, and GD-9L operated by compressed air, having clean-up width ranges of 60 to 102 in.

Ore Haulage — Manufacturers of mine cars are offering larger and lighter-weight cars for ore haulage, thereby furthering the trend of lower costs per ton of rock moved. C. S. Card Iron Works, Denver, supplied several copper-mining companies with large-capacity mine cars whose weight had been reduced about 10 per cent by the use of nickel-copper alloys supplied by the Republic Steel Corporation. The American Car & Foundry

Company, New York, N. Y., brought out a new electrically welded mine car featuring greater capacity and less weight. Sanford-Day Iron Works, Knoxville, Tenn., announced an interesting development in mechanized mining during 1938 by the company's underground rubber-tired trailer for large-capacity short hauls underground. The unit requires no trackage, and is transported by Exide storage batteries placed on a small truck. Atlas Car & Manufacturing Company, Cleveland, Ohio, reported improvements in design in its storage-battery locomotives.

For automatically controlling the recharging of storage batteries for locomotives, the Electric Storage Battery Company, Philadelphia, Pa., brought out the Exide Charge Control unit that contributes toward more accurate recharging of batteries.

Ohio Brass Company, Mansfield, Ohio, introduced new products designed to aid mechanized mining. Among new line materials, the heavy-duty M-6 section insulator switch, the new Bulldog feeder clamp, and the hanger-mounted standard quick-break switch were announced. The company brought out three new types of rail bonds, the Wedge type, the AW-20 Hook Terminal steel arc-weld bond, and the new Temporary Set-Screw Bond. New developments in the O-B automatic coupling now permit use of any type of mine car. For use in aërial transport, the American Steel & Wire Company, Cleveland, announced its tramway division is prepared to furnish drop-forged steel wheels giving greater life to the locked-coil track cables on aërial tramways.

For quicker and simpler lubrication of mine-car wheels, the Alemite division of Stewart-Warner Corporation, Chicago, Ill., brought out an electric grease gun for mine cars.

As costs rise in deeper open-pit mining operations, especially in the Iron Country, study is constantly being made to determine the most efficient technique in ore transport. Manufacturers of trucks, conveyors, tractors, and wagons contributed toward this problem in 1938. A Caterpillar tractor hauling a 15-ton Athey wagon and a White 20-ton truck were some of the largest units of this type used at mines here during the year. R. G. LeTourneau, Inc., Peoria, Ill., announced a large materials-moving unit known as the Tournapull, equipped with Caterpillars' largest diesel engine, of 160 hp., that is geared to rubber-tired wheels 80 in. in diameter. This hauls a 30-cu.yd. Tournatrailer. The Caterpillar Tractor Company, Peoria, Ill., announced the 25½-hp. D2, smallest of the current Caterpillar diesel tractor line, for hauling supplies, building mine roads and scraping purposes. Allis-Chalmers Manufacturing Company, Milwaukee, announced its new Model "S" 7766-hp. tractor for general use.

Hauling capacity is 30 cu.yd.

Hoists—As mines go deeper, manufacturers of large hoists get specifications for equipment to meet these new conditions. Nordberg Manufacturing Company, Milwaukee, Wis., started construction in 1938 of some unusually large hoists for such requirements in deep gold and copper mines. One of these large hoists required a quarter of a million dollars' worth of electrical machinery, that was supplied by Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa.

Wire Rope—Changing technique in mining methods, such as greater use of scrapers, larger-capacity dredges, and greater hoisting distances, has placed new demands on manufacturers of wire rope, which have been met. Improvements in construction and metallurgical treatment of wire for use in mining equipment was announced by Macwhyte Company, Kenosha, Wis.

Crushing and Grinding—To fill the growing need for a crusher capable of reducing large rocks to ball-mill feed, in one pass, the Straub Manufacturing Company, Oakland, Calif., introduced its Kue-Ken balanced crusher that can produce within limits of capacity and reduction, in a single operation, a finished product that ordinarily could be obtained only by using a primary crusher followed by one or two finishing machines. The Universal Crusher Company, Cedar Rapids, Iowa, announced a larger "streamlined" crusher following the smaller unit brought out early in 1938. Eimco Corporation, Salt Lake City, Utah, late in 1938 announced a line of four sectionalized jaw crushers equipped with an automatic forced-feed lubrication system.

Electric "ear" that adjusts mill feed

The electric "eye" now has a companion in the electric "ear" which has been devised by the Hardinge Company, Inc., York, Pa., for use in grinding circuits. The "ear" records the sound of the mill's operation and automatically controls the feed rate.

The advantages of a free opening at the discharge end of Marcy ball mills continue to be established at several Canadian gold properties, according to the Mine & Smelter Supply Company, Denver, Colo.

Classifiers and Tables—The widely varying requirements for grinding are being met more closely than ever before. The Dorr Company, New York, N. Y., announced the Type FH in 4- and 5-ft. widths that replaces the 3- and 4-ft. width of the former Simplex Type F classifiers. Features are Duplex rakes, less power consumption, and better-balanced mechanism. Type FX is a new 5-ft. wide heavy-duty classifier and for pilot plants the new Duplex classifier, 18 in. by 12 ft. long, was introduced. The company also announced improvements that permit a wider field of application for its washing tray thickener. Its 175- and 200-ft. diameter Torq thickeners are now equipped with a torque-actuated, self-raising and -lowering rake arms for automatic overload relief. An automatic density control has been devised by Mine & Smelter Supply Company, Denver, Colo., to control the dilution of classifier overflows in ball-mill grinding circuits.

Deister Concentrator Company, Fort Wayne, Ind., announced the new Concenco anti-friction bearing head-motion unit for inreasing capacities on diagonal-deck Deister-Overstrom concentrating tables.

Screens—W. S. Tyler Company, Cleveland, Ohio, introduced its new Ty-Rock screen for coarse screening that combines the application of circle-throw action with the advantage of a full floating positive-drive eccentric shaft.

A new heavy-duty Leahy No-Blind vibrating screen for V-belt drive known as Model C was announced by The Deister Concentrator Company. The model is offered for problems of screening at fine meshes.

Belting and Conveying—Stephens-Adamson Manufacturing Company, Aurora, Ill., introduced a novel device known as the "Wringer" type pressure pulley, that is said to give a conveyor belt 37 per cent greater contact with the drive pulley.

Sprout, Waldron & Company, Muncy, Pa., announced a new dust-proof, weather-tight materials-handling unit for wide application known as the Sprout-Waldron vertical screw elevator.

Separators—The principal development in the Sutton Steele & Steele air table was reported to be the ability to separate material of much larger size than heretofore. Use of the air table with an unriffled deck is said to have shown promise for the separation of materials of close specific gravity.

Stearns Magnetic Manufacturing Company, Milwaukee, Wis., reported

greater drawing power in its magnetic pulleys. Greater radiation in a new ribbed construction was designed, including deeper coil pockets. New York Concentrators, Ltd., 3411 RCA Building, New York, N. Y., announced a device for dry separation of minerals from gangue of fine mesh by the Schramm system employing a partial vacuum.

Flotation Equipment—Among developments by the Denver Equipment Company, Denver, Colo., the company announced the No. 30 Denver "Sub-A" (Fahrenwald) flotation machine to be built in 2-, 4-, 6-, and 8-cell units, having 56x56-in. cells. A trend toward larger individual flotation circuits has created a need for larger mechanical units of this type. The company also announced a 6-in. Denver adjustable-stroke diaphragm pump for heavy-duty work in pumping thickener underflow. The Galigher Company, Booth-Thompson Division, Salt Lake City, Utah, announced improvements in its No. 24 and 36 Agitair flotation machine.

Successful flotation of a deslimed dredge sand, relatively coarse and having a high specific gravity, was reported by the American Cyanamid Company, New York, N. Y., by its new SS type Fagergren flotation machine. Tests on fine materials running 40 per cent minus 10 microns are also reported successful.

Pan American Engineering Company, Berkeley, Calif., announced the development of a new large-capacity mechanical flotation machine under the Drake-Gardella patents for use in large metal-treating plants.

Among new flotation reagents in 1938 the Great Western Electro-Chemical Company, San Francisco, Calif., announced a xanthate known as isopropyl xanthate, Z-9.

Recent design of filters does not require the scraper to touch the filter cake for complete cake removal. Oliver United Filters report this design in the company's filters and also that woven-glass filter cloth on its filter units is meeting with considerable success.

Drying of extremely fine tungsten concentrate was announced by the Western Precipitation Corporation, Los Angeles, Calif., by a new unit called a Dispersion dryer.

Pumps and Valves—A new type of valve for use in pipe-line circuits in mills is being developed and manufactured by the Allen-Sherman-Hoff Company, Philadelphia. Known as the "Flap" and Port valves, they range in size from 3 to 12 in. in diameter. The former has a gate of the 90-deg. swinging type carried on a yoke and operated by a hand wheel, chain wheel, or electric motor. The Port Valve is so designed that the opening in the plug is the full diameter and shape of the pipe.

1938 Equipment

The compact Type K pump unit for handling sludges and other materials was announced by Morris Machine Works, Baldwinsville, N. Y. Barrett, Haentjens & Company, Hazleton, Pa., introduced the company's Type "M" check valve equipped with a Mercoid switch, that offers protection against pumps running dry. MacClatchie Manufacturing Company, Compton, Calif., announced its "Hydro-Seal" universal plug valve for all applications.

Feeders—For feeding reagents from hopper bottom into circuits, the Syntron Company, Homer City, Pa., brought out a new, smaller vibrating unit known as GFM-0-30, which is equipped with a pulsating electromagnet vibrator. Among automatic continuous weighing machines the Merrick Scale Manufacturing Company, Passaic, N. J., introduced its new Feed-O-Weight unit for handling material into process.

Allis-Chalmers Manufacturing Company announced a new Utah electromagnetic vibrating grizzly feeder for use ahead of crushers to scalp out fines; also for use in loading conveyor belts.

Jigs—Interest in applying jigs to placer operations continues, and in addition to use in large bucket-line gold dredges, application increased among the smaller dragline and floating dredge type of units. The Pan American Engineering Company, Berkeley, Calif., reports that its balanced type Placer jigs are being used in all the company's recent installations on gold dredges.

Welding—New pieces of apparatus introduced by The Linde Air Products Company, New York, N. Y., during 1938 were its new Pinox No. 34 welding blowpipe for medium range welding and its Oxweld Type W-30 lead-burning blowpipe. Lincoln Electric Company, Cleveland, Ohio, offered a new Shield Arc welder equipped with a new self-indicating dual continuous control.

Dust Control—A result of a thorough investigation by the Board of Standards and Appeals of New York State in the field of practical methods of protection against dust hazards in dry drilling was the announcement of approval of three dust-control devices of the dry suction type. This approval covered eight units manufactured by the Kadco Corporation, and two of the Markely Dust Control System, of New York, N. Y., respectively, and four units made by the Spencer Turbine Company, Hartford, Conn. Approval of equipment for use in wet drilling in New York State was announced late in the year that covered a total of 84 rock drills. Manufacturers who had equipments approved were Chicago-Pneumatic Tool Company, Cleveland Rock Drill Company, Gardner-Denver Company, Ingersoll-Rand, Independent-Pneumatic, Sullivan Manufacturing Company, and Worthington Pump & Machinery Corporation.

A mobile dust collector was announced by Western Precipitation Corporation, Los Angeles, Calif. The unit consists of a combination of Multiclones followed by bag filters, the complete unit built on a car which moves with the tripper. New dust-sampling instruments announced by Mine Safety Appliances, Pittsburgh, Pa., were the M.S.A. Midget Impinger and M.S.A. Electrostatic Dust and Fume Sampler.

Excavators—Advance in design and use of new alloys that provide great strength and light weight permit manufacturers of excavating equipment to offer machinery that increases output and lowers costs. New shovels announced by Bucyrus-Erie Company, South Milwaukee, Wis., were the 20B ¾-cu.yd. unit; 18B, of ⅝-cu.yd. capacity; the 22B, a heavy-duty ¾-cu.yd. machine; and the 24B, a 1-cu-yd. excavator. In the mining field, machines of 3-cu.yd. capacity and higher are becoming more in demand and the company is offering the Bucyrus-Monighan 3W, 5W, and the 9W dragline units of large capacity. Lima Locomotive Works, Inc., Lima, Ohio, announced their new ¾-yd. Paymaster equipped as clamshell or dragline. Marion Steam Shovel Company, Marion, Ohio, announced a new line of excavators of 1¼-, 1½-, 1¾-, 2-, 1- and 2½-cu.yd. capacity.

A system of oil hydraulic control for both scraper and cableway hoists as an alternative to the air, electric and hand lever control was developed by Sauerman Bros., Chicago, Ill. Greater control of clutches and brakes is claimed for this type of equipment.

Safety First—Among developments in this important activity of the mining industry, the American Optical Company developed its R1000 respirator against silica-dust hazards. The Portable Lamp & Equipment Company, Pittsburgh, Pa., offered an improved mine-car stop for safely holding a mine car in one particular spot. A one-hour oxygen breathing apparatus that permits easy voice communication between men in gas- or smoke-filled areas was introduced by Mine Safety Appliances Company, Pittsburgh, Pa. E. D. Bullard Company announced improvement in its line of Tuff Nut hats.

The B. F. Goodrich Company, Akron, Ohio, offered a folded rubber guard to prevent body contact with underground trolley wires. The Manhattan Rubber Manufacturing Company, Passaic, N. J., announced a rubber device for similar protection.

Summary of the

MARKETS

BUYERS of non-ferrous metals had to face a somewhat less optimistic picture of business conditions in January than generally anticipated, with the result that purchases were on a greatly reduced scale. London prices declined, sterling exchange was unsettled, and security values broke sharply, which developments made for some uncertainty about the stability of prices. Political disturbances in Europe were largely responsible for the absence of support in the London market.

The *E.&M.J.* index number of non-ferrous metal prices for January was 77.12, which compares with 77.13 in December and 75.56 in January of the year previous. The slight drop was due to a lower average for lead.

Domestic sales of copper for January amounted to only 15,507 tons, against 15,080 tons in December. The price named by producers continued at 11.25c., Connecticut Valley. Though the London equivalent was substantially below the domestic level, there was no talk of lowering the price. Producers believe that as soon as the political situation abroad shows improvement, the price in London will strengthen appreciably. Output in the United States is being curtailed to meet the lessened demand.

The threat of imports depressed both lead and zinc. The price of lead was dropped 10 points on Jan. 24, but the quotation moved back to 4.85c., New York, on the last day of the month. There was no change in the zinc situation, with producers disappointed over the firm position taken by the State Department in its defense of the lower duty.

Tin weakened on Jan. 26 on rumors that the Buffer Pool has been selling. This was denied and prices quickly recovered. Antimony was reduced one-half cent. Quicksilver advanced.

E.&M.J. metal prices, summarized herewith for the preceding month, are also published weekly in "*E.&M.J. Metal and Mineral Markets*" for those who need current information. Sample copy and subscription rates on request.

UNITED STATES MARKET

1939 Jan.	Electrolytic Copper Domestic (a)	Electrolytic Copper Export (b)	Straits Tin New York	Lead New York	Lead St. Louis	Zinc St. Louis
2	Holiday	Holiday	Holiday	Holiday	Holiday	Holiday
3	11.025	10.100	46.400	4.85	4.70	4.50
4	11.025	10.100	46.550	4.85	4.70	4.50
5	11.025	10.150	46.500	4.85	4.70	4.50
6	11.025	10.125	46.750	4.85	4.70	4.50
7	11.025	10.150	46.750	4.85	4.70	4.50
9	11.025	10.150	46.675	4.85	4.70	4.50
10	11.025	9.975	46.750	4.85	4.70	4.50
11	11.025	9.950	46.700	4.85	4.70	4.50
12	11.025	9.825	46.675	4.85	4.70	4.50
13	11.025	9.850	46.600	4.85	4.70	4.50
14	11.025	9.850	46.600	4.85	4.70	4.50
16	11.025	9.875	46.500	4.85	4.70	4.50
17	11.025	9.850	46.500	4.85	4.70	4.50
18	11.025	9.875	46.700	4.85	4.70	4.50
19	11.025	9.900	46.600	4.85	4.70	4.50
20	11.025	9.925	46.550	4.85	4.70	4.50
21	11.025	9.900	46.500	4.85	4.70	4.50
23	11.025	9.825	46.200	4.85	4.70	4.50
24	11.025	9.825	46.250	4.75	4.60	4.50
25	11.025	9.775	46.000	4.75	4.60	4.50
26	11.025	9.775	45.200	4.75	4.60	4.50
27	11.025	9.725	45.900	4.75	4.60	4.50
28	11.025	9.725	45.900	4.75	4.60	4.50
30	11.025	9.750	45.950	4.75	4.60	4.50
31	11.025	9.850	46.400	4.85	4.70	4.50
AVERAGES FOR MONTH						
	11.025	9.912	46.404	4.826	4.676	4.500
AVERAGES FOR WEEK						
Jan.						
4	11.025	10.125	46.580	4.850	4.700	4.500
11	11.025	10.083	46.688	4.850	4.700	4.500
18	11.025	9.854	46.596	4.850	4.700	4.500
25	11.025	9.858	46.350	4.817	4.667	4.500
CALENDAR WEEK AVERAGES						
Jan.						
7	11.025	10.125	46.590	4.850	4.700	4.500
14	11.025	9.933	46.667	4.850	4.700	4.500
21	11.025	9.888	46.558	4.850	4.700	4.500
28	11.025	9.775	45.908	4.767	4.617	4.500

SILVER, GOLD, AND STERLING EXCHANGE

NEW YORK AND LONDON

1939 Jan.	Sterling Exchange "Checks"	Sterling Exchange "90-day demand"	Silver (c) New York	Silver London	Gold London	Gold (d) United States
2	Holiday	Holiday	Holiday	Holiday	Holiday	Holiday
3	4.625000	4.600625	42.750	21.1250	150s ¼d	$35.00
4	4.632500	4.606875	42.750	20.9375	150s 5d	35.00
5	4.630000	4.606875	42.750	20.6250	150s 1d	35.00
6	4.643750	4.622500	42.750	20.5000	149s 6d	35.00
7	4.680000	4.662500	(e)	20.3125	148s 9½d	35.00
9	4.671250	4.653750	42.750	20.3125	148s 7½d	35.00
10	4.672500	4.652500	42.750	20.3125	149s	35.00
11	4.670000	4.650000	42.750	20.3125	148s 10d	35.00
12	4.667500	4.647500	42.750	20.3750	148s 9½d	35.00
13	4.667500	4.646875	42.750	20.2500	148s 11d	35.00
14	4.675000	4.652500	(e)	20.5000	148s 9½d	35.00
16	4.672500	4.651250	42.750	20.3750	148s 8½d	35.00
17	4.676250	4.658750	42.750	20.3125	148s 8½d	35.00
18	4.681250	4.666250	42.750	20.1250	148s 7½d	35.00
19	4.680000	4.665000	42.750	20.0625	148s 5½d	35.00
20	4.680000	4.665000	42.750	20.0625	148s 7d	35.00
21	4.673125	4.658125	(e)	20.1875	148s 8½d	35.00
23	4.675000	4.661250	42.750	20.1875	148s 8½d	35.00
24	4.673750	4.658750	42.750	20.2500	148s 8½d	35.00
25	4.673750	4.658750	42.750	20.1875	148s 8½d	35.00
26	4.673750	4.658750	42.750	20.1250	148s 8d	35.00
27	4.672500	4.656250	42.750	19.9375	148s 8½d	35.00
28	4.675625	4.659375	(e)	20.1875	148s 8½d	35.00
30	4.675000	4.658750	42.750	20.0625	148s 7½d	35.00
31	4.676250	4.660000	42.750	20.0000	148s 6d	35.00
Average for Mo	4.66775	.....	42.750	20.305	.....	35.00
AVERAGES FOR WEEK						
Jan.						
4	4.64025	.....	42.750	.....	.....	.....
11	4.66125	.....	42.750	.....	.....	.....
18	4.67333	.....	42.750	.....	.....	.....
25	4.67594	.....	42.750	.....	.....	.....

Calendar week averages: New York Silver Jan. 7th 42.750; 14th 42.750; 21st 42.750; 28th 42.750.

(e) Not quoted (Saturday).

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis add 0.225c. per pound, the average differential for freight and delivery charges.

(b) Export prices are net at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. Most sales in the foreign market are made on the basis of c.i.f. usual ports of destination—Hamburg, Havre, and Liverpool. The c.i.f. basis commands a premium of 0.325c. per pound above our refinery quotation.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes are sold at a discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c. per pound over the current market for Prime Western but not less than 1c. over the *Engineering and Mining Journal's* average quotation for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(c) Silver other than newly mined domestic. Under Executive order effective Jan. 1, 1939, the U. S. Government's price on newly mined domestic silver was established at 64.64c. Handy & Harman's quotation for domestic silver, 999 fine, was 64⅛c. per ounce throughout January.

(d) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in domestic and imported ore or concentrate is at 99.75 per cent of the price quotated by the Treasury, which at present is equal to $34.9125 per ounce.

PRICES OF METALS • MISCELLANEOUS QUOTATIONS

LONDON MARKET

1939 Jan	COPPER Standard Spot	COPPER Standard 3 months	COPPER Electro Bid	TIN Standard Spot	TIN Standard 3 months	LEAD Spot Buyers	LEAD Spot Sellers	LEAD 3 months Buyers	LEAD 3 months Sellers	ZINC Spot Buyers	ZINC Spot Sellers	ZINC 3 months Buyers	ZINC 3 months Sellers
2						Holiday							
3	44.5625	44.8125	50.0000	217.0000	218.0000	14.8750	14.9375	15.1250	15.1875	13.6875	13.7500	13.9375	14.0000
4	44.3125	44.5625	50.0000	217.0000	218.0000	14.8125	14.8750	15.0625	15.1250	13.7500	13.8125	13.9375	14.0000
5	44.8125	45.0625	50.0000	217.6250	218.5000	14.8750	14.9375	15.1250	15.1875	13.8750	13.9375	14.1250	14.1875
6	44.3750	44.6250	50.0000	217.0000	217.7500	14.7500	14.8125	15.0000	15.0625	13.6250	13.7500	13.8750	13.9375
9	44.1250	44.3750	49.5000	217.2500	218.2500	14.5625	14.6250	14.8125	14.8750	13.5625	13.6250	13.8125	13.8750
10	43.5000	43.7500	48.5000	216.5000	217.5000	14.6250	14.7500	14.8750	15.0000	13.4375	13.5000	13.6875	13.7500
11	43.6875	43.9375	48.5000	217.0000	218.0000	14.7500	14.8750	14.9375	15.0000	13.6875	13.7500	13.8750	13.9375
12	42.6875	43.0625	47.7500	216.2500	217.0000	14.5000	14.5625	14.6875	14.7500	13.5000	13.5625	13.6875	13.8125
13	42.9375	43.1875	48.0000	216.2500	217.1250	14.6250	14.7500	14.8750	14.9375	13.9375	14.0000	14.0625	14.1250
16	43.0625	43.3750	48.2500	216.0000	216.7500	14.4375	14.5625	14.6875	14.7500	13.8125	13.8750	13.9375	14.0000
17	42.5000	42.7500	48.0000	215.5000	216.3750	14.3125	14.4375	14.5625	14.6250	13.7500	13.8750	14.0000	14.0625
18	43.0625	43.3125	48.0000	216.3750	217.1250	14.5000	14.5625	14.6875	14.7500	13.6875	13.7500	13.9375	14.0000
19	43.0000	43.3125	48.2500	216.3750	217.0000	14.4375	14.5625	14.6250	14.6875	13.8125	13.8750	14.0625	14.1250
20	42.9375	43.3125	48.2500	216.2500	216.7500	14.2500	14.3750	14.5000	14.5625	13.5625	13.6875	13.8750	13.9375
23	42.4375	42.7500	47.7500	213.7500	214.7500	14.0000	14.1250	14,3125	14,3750	13,3750	13,5000	13,6250	13,6875
24	42.3125	42.6250	48.5000	214.5000	215.2500	14.1250	14.2500	14.3750	14.4375	13.5625	13.6250	13.7500	13.8125
25	42.2500	42.5000	47.5000	213.2500	213.7500	14.3125	14.4375	14.5000	14.5625	13.4375	13.5625	13.6875	13.7500
26	42.0000	42.3125	47.5000	208.7500	209.2500	14.0625	14.1875	14.3125	14.3750	13.3750	13.5000	13.5625	13.6250
27	41.8750	42.1250	47.2500	211.7500	211.5000	14.1250	14.2500	14.3750	14.4375	13.5625	13.6875	13.6875	13.8125
30	42.3125	42.6250	47.5000	213.5000	212.5000	14.5000	14.6250	14.6250	14.6875	13.6875	13.7500	13.8125	13.8750
31	42.8750	43.2500	48.2500	216.2500	215.2500	14.6875	14.8125	14.8750	14.9375	13.7500	13.8125	13.9375	14.0625
Average for month...	43.125	.....	48.440	215.435	.....	14.534		14.744		13.682		13.887	

Prices for lead and zinc are the official prices for the first session of the London Metal Exchange; prices for copper and tin are the official closing buyers prices. All are in pounds sterling per long ton of 2,240 lb.

CURRENT PRICES — MISCELLANEOUS METALS, ORES, AND NON-METALLIC MINERALS

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated

(Feb. 1, 1939)

MISCELLANEOUS METALS

Aluminum, ingot, 99 plus per cent, lb	20c.
Antimony, domestic, spot, lb	11.250c.
Bismuth, ton lots, lb	$1.05
Cadmium, lb	55@80c.
Calcium, lb., ton lots 97 @ 98 per cent	75c.
Chromium, 97 per cent grade, lb	85c.
Nickel, electrolytic cathodes, lb	35c.
Magnesium, 99.8 per cent, carloads, lb	30c.
Palladium, troy oz	$24.00
Platinum, (Official quotation) troy oz	$35.00
Quicksilver, flask of 76 lb., 100 flasks or more	$80.00@$82.00
Radium, mg. radium content	$40.00
Selenium, 99.5 per cent, lb	$1.75
Silicon, minimum 97 per cent, spot, lb	16.50c.
Tellurium, lb	$1.75
Thallium, 100 lb. or more, lb	$6.50
Titanium, 96 to 98 per cent, lb	$5.00

METALLIC ORES

Beryllium Ore, f.o.b. mines, ton	$30.00@$35.00
Chrome Ore, 48 @ 50 per cent, c.i.f. Atl. ports, long ton	$22.00@$23.00
Iron Ore, Lake Superior, Lower Lake ports, long ton:	
Old Range bessemer	$5.25
Mesabi bessemer	$5.10
Old Range non-bessemer	$5.10
Mesabi, non-bessemer	$4.95
Lead (Galena) 80 per cent, Joplin, Mo., ton	$54.38
Manganese Ore, c.i.f. Atlantic ports, long ton unit:	
52 @ 55 per cent	30c.
50 @ 52 per cent	28@30c.
44 @ 48 per cent	25c.
Molybdenum Ore, 90 per cent, per lb. of contained MoS_2	45c.
Tungsten Ore, per unit of WO_3:	
Chinese, 65 per cent, duty paid	$20.00
Domestic, 65 per cent and upward	(a)$16.00@$18.00
Vanadium Ore, per lb. of contained V_2O_5	27½c.
Zinc Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton.	$29.00

(a) Prices at mines, small lots, usually several dollars less.

METALLIC COMPOUNDS

Arsenious Oxide (arsenic) lb	3c
Cobalt Oxide, 70 @ 71 per cent, lb	$1.67@$1.77
Copper Sulphate, 100 lb	$4.50
Sodium Nitrate, ex vessel, in 200-lb. bags, per 100 lb	$1.42
Sodium Sulphate, bulk, ton	$13.00@$15.00

ALLOYS

Beryllium Copper, master alloy, 2.5 to 3 per cent Be, per lb. of contained Be	$23.00
Ferrochrome, 65 @ 70 per cent chromium, 4 @ 6 per cent carbon, lb	10½c.
Ferromanganese, 78 @ 82 per cent, gross ton	$80.00
Ferromolybdenum, 55 @ 65 per cent Mo. lb. of Mo contained.	95c
Ferrosilicon, 50 per cent, gross ton	$69.50
Ferrotungsten, 75 @ 80 per cent, lb. of W contained	$1.65

NON-METALLIC MINERALS

Asbestos, f.o.b. mines, ton:	
Canadian (Quebec)	
Crude No. 1	$700@$750
Crude No. 2	$150@$350
Spinning fibers	$110@$200
Paper stock	$40@$45
Shorts	$12@$16.50
Vermont	
Shingle stock	$57
Paper stock	$40
Cement stock	$25
Barytes, long ton:	
Georgia, crude	$7.00
Missouri, 90 per cent $BaSO_4$, less than 1 per cent iron	$6.00@$7.00
Bauxite, long ton:	
Domestic, chemical, 55 @ 58 per cent	$6.00@$7.00
Domestic, abrasive, 80 @ 84 per cent	$12.00@$14.00
Dalmatian, 50 @ 55 per cent	(a)$6.50@$7.50
French, 56 @ 59 per cent	(a)$7.50@$8.50
China Clay, f.o.b. mines, ton:	
South Carolina and Georgia, No. 1, bulk	$6.75@$8.00
Delaware, No. 1	$14.50
Feldspar, bulk, ton:	
Potash feldspar, 200 mesh	$17.00
Glass-spar, white, 20 mesh	$11.75
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 85–5 per cent, all rail movement, ton	$18.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00@$14.00
Magnesite, per ton:	
Dead-burned, f.o.b. California	$25.00
Dead-burned, f.o.b. Washington	$22.00
Mica, per lb., North Carolina, No. 1 and 2 quality:	
1½ x 2 in	15@35c.
2 x 2 in	30@50c.
3 x 3 in	75@$1.00
3 x 4 in	$1.00@$1.30
4 x 6 in	$2.00@$2.50
White, ground, 70 mesh, ton	$60.00@$80.00
Ocher, Georgia, ton	$19.00@$22.00
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports	(a) 12@12½c.
Silica, in bags, 325 mesh, ton	$18.00@$40.00
Sulphur, Texas mines, long ton	$16.00
Talc, f.o.b. works, ton:	
New York, double air-floated, 325 mesh	$12.00@$15.00
New Jersey, mineral pulp	$8.00@$10.00
Vermont, extra white, 200 mesh	$9.00@$9.50
Tripoli, Missouri, ton:	
40 mesh, cream colored	$14.50
200 mesh, cream colored	$26.00

(a) Nominal

IRON AND STEEL

Pig Iron, Valley furnaces, gross ton:	
Bessemer	$21.50
Basic	$20.50
No. 2 Foundry	$21.00
Steel, base prices, Pittsburgh:	
Billets, gross ton	$34.00
Structural shapes, 100 lb	$2.10
Bars, 100 lb	$2.25

Monthly and Yearly

AVERAGE PRICES

SILVER AND STERLING EXCHANGE

	New York		London Spot		Sterling Exchange	
	1938	1939	1938	1939	1938	1939
January	44.750	42.750	19.895	20.305	499.895	466.775
February	44.750	.....	20.159	.....	501.722	.....
March	44.446	.....	20.088	.....	498.394	.....
April	42.750	.....	18.880	.....	498.046	.....
May	42.750	.....	18.731	.....	496.673	.....
June	42.750	.....	18.945	.....	495.772	.....
July	42.750	.....	19.356	.....	492.855	.....
August	42.750	.....	19.389	.....	488.044	.....
September	42.750	.....	19.300	.....	480.240	.....
October	42.750	.....	19.613	.....	476.785	.....
November	42.750	.....	19.834	.....	470.587	.....
December	42.750	.....	20.083	.....	466.798	.....
Year	43.225	.....	19.523	.....	488.818	.....

New York quotations for silver other than newly-mined domestic, cents per ounce troy, 999 fine, London, pence per ounce sterling silver 925 fine. Sterling exchange (pound sterling) in cents.

COPPER

	F.O.B. Refinery, Electrolytic				London Spot			
	Domestic		Export		Standard		(a) Electrolytic	
	1938	1939	1938	1939	1938	1939	1938	1939
January	10.198	11.025	9.908	9.912	41.387	43.125	45.387	48.440
February	9.775	.....	9.525	.....	39.597	.....	43.563	.....
March	9.775	.....	9.496	.....	39.772	.....	43.582	.....
April	9.775	.....	9.443	.....	39.306	.....	43.408	.....
May	9.375	.....	8.801	.....	36.668	.....	40.852	.....
June	8.775	.....	8.500	.....	35.235	.....	39.417	.....
July	9.585	.....	9.573	.....	39.744	.....	44.405	.....
August	9.900	.....	9.844	.....	40.591	.....	45.909	.....
September	10.028	.....	9.943	.....	41.864	.....	47.148	.....
October	10.760	.....	10.713	.....	45.646	.....	51.190	.....
November	11.025	.....	10.569	.....	45.244	.....	51.080	.....
December	11.025	.....	10.023	.....	43.428	.....	48.988	.....
Year	10.000	.....	9.695	.....	40.707	.....	45.411	.....

New York quotations, cents per pound. London, pounds sterling per long ton, (a) Bid quotation.

LEAD

	New York		St. Louis		London			
	1938	1939	1938	1939	1938 Spot	1938 3 mos.	1939 Spot	1939 3 mos.
January	4.870	4.826	4.720	4.676	16.135	16.253	14.534	14.744
February	4.632	.....	4.482	.....	15.402	15.525	.....	.....
March	4.500	.....	4.350	.....	15.992	16.075	.....	.....
April	4.500	.....	4.350	.....	15.579	15.623	.....	.....
May	4.400	.....	4.250	.....	14.210	14.376	.....	.....
June	4.148	.....	3.998	.....	13.969	14.012	.....	.....
July	4.882	.....	4.732	.....	14.921	15.034	.....	.....
August	4.900	.....	4.750	.....	14.371	14.480	.....	.....
September	4.998	.....	4.848	.....	15.249	15.401	.....	.....
October	5.100	.....	4.950	.....	16.173	16.313	.....	.....
November	5.091	.....	4.941	.....	16.088	16.223	.....	.....
December	4.842	.....	4.692	.....	15.106	15.275	.....	.....
Year	4.739	.....	4.589	.....	15.266	15.383	.....	.....

New York and St. Louis quotations, cents per pound. London pounds sterling per long ton.

TIN

	Straits New York		Standard, Spot London	
	1938	1939	1938	1939
January	41.548	46.404	183.619	215.435
February	41.373	.....	183.144	.....
March	41.219	.....	183.473	.....
April	38.430	.....	168.612	.....
May	36.885	.....	162.693	.....
June	40.376	.....	177.429	.....
July	43.428	.....	192.542	.....
August	43.276	.....	192.966	.....
September	43.369	.....	193.733	.....
October	45.263	.....	206.911	.....
November	46.262	.....	213.909	.....
December	46.180	.....	214.450	.....
Year	42.301	.....	189.457	.....

New York quotations cents per pound. London, pounds sterling per long ton.

ZINC

	St. Louis		London			
	1938	1939	1938 Spot	1938 3 mos.	1939 Spot	1939 3 mos.
January	5.000	4.500	14.994	15.173	13.682	13.887
February	4.813	.....	14.408	14.589	.....	.....
March	4.417	.....	14.364	14.477	.....	.....
April	4.141	.....	13.729	13.919	.....	.....
May	4.042	.....	12.682	12.869	.....	.....
June	4.131	.....	12.890	13.104	.....	.....
July	4.745	.....	14.144	14.371	.....	.....
August	4.750	.....	13.467	13.675	.....	.....
September	4.846	.....	14.040	14.246	.....	.....
October	5.012	.....	15.083	15.232	.....	.....
November	4.924	.....	14.366	14.550	.....	.....
December	4.500	.....	13.709	13.861	.....	.....
Year	4.610	.....	13.990	14.172	.....	.....

St. Louis quotations, Prime Western, cents per pound. London, pounds sterling per long ton.

CADMIUM AND ALUMINUM

	Cadmium			Aluminum	
	1938 (a)	1939 (a)	1939 (b)	1938	1939
January	117.500	70.900	58.400	20.000	20.000
February	117.500	.....	.....	20.000	.....
March	117.500	.....	.....	20.000	.....
April	102.500	.....	.....	20.000	.....
May	102.500	.....	.....	20.000	.....
June	102.500	.....	.....	20.000	.....
July	102.500	.....	.....	20.000	.....
August	99.722	.....	.....	20.000	.....
September	84.000	.....	.....	20.000	.....
October	80.000	.....	.....	20.000	.....
November	77.717	.....	.....	20.000	.....
December	72.500	.....	.....	20.000	.....
Year	98.037	.....	.....	20.000	.....

Aluminum in cents per pound, 99 plus per cent grade. Cadmium, cents per pound; (a) average of producer's and plater's quotations; (b) producers' price, commercial sticks.

ANTIMONY, QUICKSILVER, AND PLATINUM

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1938	1939	1938	1939	1938	1939
January	13.750	11.670	79.240	77.440	36.000	34.440
February	13.750	.....	76.455	.....	36.000	.....
March	13.750	.....	72.444	.....	36.000	.....
April	13.654	.....	71.019	.....	36.000	.....
May	12.460	.....	74.640	.....	33.400	.....
June	11.731	.....	80.731	.....	33.231	.....
July	11.030	.....	76.860	.....	36.000	.....
August	10.880	.....	75.500	.....	37.000	.....
September	11.310	.....	74.420	.....	39.000	.....
October	12.060	.....	73.480	.....	37.960	.....
November	12.250	.....	74.065	.....	36.217	.....
December	11.567	.....	76.769	.....	34.000	.....
Year	12.349	.....	75.469	.....	35.901	.....

(a) Antimony, cents per pound, ordinary brands, in cases; in bulk deduct .250c. (b) Quicksilver, dollars per flask of 76 lb. (c) Platinum is dollars per ounce troy.

PIG IRON

	Bessemer		Basic		No. 2 Foundry	
	1938	1939	1938	1939	1938	1939
January	24.50	21.50	23.50	20.50	24.00	21.00
February	24.50	.....	23.50	.....	24.00	.....
March	24.50	.....	23.50	.....	24.00	.....
April	24.50	.....	23.50	.....	24.00	.....
May	24.50	.....	23.50	.....	24.00	.....
June	23.73	.....	22.73	.....	23.23	.....
July	20.50	.....	19.50	.....	20.00	.....
August	20.50	.....	19.50	.....	20.00	.....
September	20.50	.....	19.50	.....	20.00	.....
October	21.50	.....	20.50	.....	21.00	.....
November	21.50	.....	20.50	.....	21.00	.....
December	21.50	.....	20.50	.....	21.00	.....
Year	22.686	.....	21.686	.....	22.186	.....

Iron, dollars per long ton. F. o. b. Mahoning and Chenango Valley furnaces.

PERSONAL ITEMS

H. W. Hardinge has gone to Tucson, Ariz., on consulting work.

Ben Payne, Jr., has left Stibnite, Idaho, and is at the Getchell mine, Golconda, Nev.

Grant Morton has opened a modern laboratory and assay office at 238 North Wilson Way, Stockton, Calif.

A. M. Tweedt, engineer of Berkeley, Calif., is directing the opening of mine properties in Nevada for J. O. Greenan.

Oliver G. Kelly is geologist and engineer for New True Fissure Mining & Milling Company, Ferguson, B. C.

I. W. Morley, formerly on the underground staff of Wiluna Gold Mines, Ltd., has been appointed inspector of mines at Kalgoorlie.

Ed. O. Carter, flotation operator at the Cactus mine, California, has gone to Rancagua, Chile, with the Braden Copper Company.

M. C. Haas, general superintendent of the Presidio mine, of the American Metal Company of Texas, recently arrived in New York.

A. W. Newberry, consulting mining engineer, has removed from Santa Barbara, Calif., to 46 Oxford St., Springfield, Mass.

W. Edwards, late of Bendigo, has been appointed mine manager of l'Aiglon Gold & Tin Syndicate, Ltd., operating near Batlow, N. S. W.

Herman L. Dauth has left Maguarichic, Chihuahua, Mexico, and gone to El Peru Bolivar, Venezuela, with New Gold Fields of Venezuela.

Prof. Maxwell Wayland Short, of the University of Arizona, was on Dec. 28 last elected president of the Mineralogical Society of America.

Sir Robert Hadfield has received the award of the Legion of Honor of the A.I.M.E. in recognition of his 50 years of support as a member.

James O. Greenan has returned to his Reno, Nev., office after inspecting mine properties he is operating in Humboldt, Lander, and Eureka counties.

J. Beattie, until recently mine superintendent for Omega Gold Mines, Ltd., Larder Lake, Canada, is now with Delrite Mines, Ltd., Timmins, Ontario.

H. I. Altshuler, consulting mining engineer, New York, will be at Cia. Minera Unificada Cerro de Potosi, Potosi, Bolivia, for about six months.

Edward H. Wisser, consulting engineer, returned to his headquarters at 74 New Montgomery St., San Francisco, from a professional trip to northern Mexico.

James S. Earle has been appointed supervising engineer of the newly created Secondary Metals Section of the Bureau of Mines. His headquarters will be at Pittsburgh, Pa. Mr. Earle has had thirteen years' practical experience as a metallurgist, a large part of which has been in the purchase, sorting, and treatment of scrap metals. Following his graduation from the University of Arizona in 1925 he was engaged in the design, construction, and operation of various copper and lead smelters. In 1929 he was appointed assistant superintendent and in 1932 superintendent of the lead refinery of the American Smelting & Refining Company at Monterrey, Mexico. In 1934 he was transferred to Perth Amboy to take charge of sorting and remelting scrap metals for the Federated Metals Corporation. Subsequently he was put in charge of the scrap smelting and refining operations at the same plant. Mr. Earle is well acquainted with the marketing and technologic aspects of the secondary-metal industry and has originated several improvements in methods of treating various types of scrap.

JAMES S. EARLE

Quentin E. Conklin, formerly with the Lodestar Mining Company, Mojave, Calif., has gone to Pulucayo, Bolivia, where he is associated with Cia. Huanchaca de Bolivia.

L. J. Joubert, general manager of Bulolo Gold Dredging, Ltd., New Guinea, recently arrived in Sydney from the United States, where he had been on a holiday visit.

Charles Dean Wilkinson, Nevada engineer who was in charge of early operations at Goldfield, is manager for the Whitmore Mines, Inc., at Soledad Mountain near Mojave, Calif.

Stanley F. O'Leary, president of the Giant Jumbo Mining Corporation, with property near Battle Mountain, Nev., has been spending some time at his former home in Holyoke, Mass.

Samuel A. Madrid, ore-dressing engineer for Kennedy-Van Saun Manufacturing & Engineering Corporation of New York, has been in Reno after visiting several Nevada mining districts.

Brian Hogg has been appointed manager of the Western Australian Government's State Battery at Peak Hill, W. A. He was formerly manager of the Prohibition mine, at Meekatharra.

E. N. Pennybaker, chief geologist for Consolidated Coppermines Corporation, is in Cuba making an examination of Minas de Matahambre property for the American Metal Company.

Herbert E. Rose, mill superintendent for the International Nickel Company at Copper Cliff, Ont., visited in the Tri-State district the middle of January as the guest of **C. Erb Wuensch.**

William H. Wright, of the Lake Shore and Wright-Hargreaves mining enterprises, has donated $100,000 to provide adequate hospital facilities to the town of Kirkland Lake, Ontario, Canada.

E. A. Slover, of the smelting department of Nevada Consolidated, at McGill, Nev., has been transferred to the company's new smelter at Hurley, N. M., where he will become smelter superintendent.

B. Bridger, formerly with Pungah Tin Dredging, Ltd., Pungah, West Siam, has been appointed manager of Redbank Dredging, N. L., Redbank, Vic. This company's dredge is approaching completion.

F. E. Meiklejohn is mill superintendent for Boston California Mining Company operating the Malvina mine, near Coulterville, Calif. He was formerly at the Eagle Shawmut mine, Chinese Camp, Calif., in the same capacity.

W. M. Archibald has resigned from the position of vice-president in charge of mines of the Consolidated Mining & Smelting Company of Canada, Ltd., after a period of some twenty years of service with the company.

James B. Cogswell has returned to the United States from San Dimas, Durango, Mexico, where he was on the engineering staff of Mexican Candelaria Company. His present address is 803 Fremont Ave., South Pasadena, Calif.

H. C. Enos is now general manager for the Magdalena mine, at Temascaltepec, Mexico, which was recently taken over under bond and lease by Lane-Rincon Mines, Inc., which is equipping the property for production.

T. P. Lane has left California for Panama to examine gold properties on the isthmus. Mr. Lane resigned some time ago as manager for the Tungsten Metals Corporation, at Ely, Nev., to take over the Bright Star mine, a gold producer near Bakersfield, Calif., which he is operating as the T. P. Lane Metals Company.

W. H. Sarrels is now associated with **M. D. Stackpole** in the production of lead-silver, tin, and antimony ores in Mexico, with headquarters at Cuencame, Durango. Mr. Stackpole was general superintendent for the Republican Mining & Metal Company, Ltd., in charge of this company's properties in Durango and Zacetecas for the past eight years.

Ira B. Joralemon, of San Francisco, president of Desert Silver, Inc., operating near Silver Peak, Nev., has been at the Dan Tucker mine, in Churchill County, Nev., which he acquired recently under option of purchase. He was accompanied by **R. Boustow,** engineer with the Bralorne Mines, Ltd.

Jack Gilbert, former district mine superintendent for the American Zinc, Lead & Smelting Company, has accepted a position as superintendent with the Eagle-Picher Mining & Smelting Company. He will be in direct charge of the latter company's mining operations in the Missouri section of the Tri-State district.

Chris. G. Dobson has resigned as mine superintendent for Britannia Mining & Smelting Company, Britannia Beach, B. C., and is taking a holiday after having guided the company's mining operations during the depression, through the period of reconstruction, and back to full-scale operation. He can be reached at 3225 West 15th Ave., Vancouver, B. C.

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OBITUARY

Dr. Hugo von Hagen, geologist, of New York City, died at Aurora, Ill., on Jan. 7. He was 73 years old.

Arthur C. Thompson, mining engineer long employed by United Verde Extension Mining Company in Arizona, died at Long Beach, Calif., on Jan. 15 at the age of 57.

William Robbins Seigle, chairman of the board and research director of the Johns Manville Corporation, died in Rochester, Minn., on Dec. 26 last. He was 59 years old.

Edwin Roy Burke, mill superintendent at Laguna Gold Mines, at Herb Lake, Manitoba, and formerly identified with other Canadian mining enterprises, died at Winnipeg Dec. 11 last at the age of 44.

James J. Warren, president of Consolidated Mining & Smelting Company of Canada, and long prominently identified with Canadian industrial and financial progress, died at Southern Pines, N. C., on Jan. 28 on the eve of his 69th birthday.

Albert Sauveur, Gordon McKay professor of metallography and metallurgy at Harvard University, died at Boston, Mass., on Jan. 26 at the age of 75. He had been a member of the faculty of the University since 1889.

George Lyman, mine superintendent of the Copper Queen Branch of Phelps Dodge Corporation, at its properties at Bisbee and Douglas, Ariz., died in the Copper Queen hospital on Jan. 4, in his 50th year. He had long been identified with the Bisbee district.

W. S. Senior, prominently identified with mining in Southern Rhodesia for many years and recently Minister for Mines and Public Works for that republic, died recently as the result of an airplane accident. He was 50 years old.

Clarence Cunningham, a prominent mining man of the Northwest, discoverer of the old Coeur d'Alene and Star mines and identified with mining in Alaska and the Slocan district of British Columbia, died at New Denver, B. C., on Jan. 15 at the age of 75.

Edgar H. Wells, president of the New Mexico School of Mines, at Socorro, N. M., died from a self-inflicted gunshot wound on Jan. 7. Mr. Wells was in his 52nd year. He had been with the school since 1917, in which year he resigned his post as assistant superintendent of Austin Dakota Mining

EDGAR H. WELLS

Company, at Austin, Nev., to become professor of mineralogy and geology at the school. He was a member of the A.I.M.E., American Mining Congress, Society of Economic Geologists, and American Association for the Advancement of Science, and was director of the State Bureau of Mines and Mineral Resources and State Geologist.

William M. Havenor, pioneer railroad and mining man and stock broker, died on Dec. 30 at the age of 93 years at his Salt Lake City home. Mr. Havenor was born in County Galway, Ireland. When a child he came witn his parents to America, where they settled at Salamanca, N. Y. As a young man, he became active on the Comstock Lode and served one term in the Nevada State Legislature before coming to Utah in 1890.

Edward N. Hawkins, metallurgist, aged 72, died in San Francisco on Nov. 20, 1938. He had been in bad health for several years. During his early career he was successively chemist, Globe Smelting & Refining Company, Denver; superintendent, Holden Smelting & Refining Company, Leadville; general manager, El Paso Reduction Company and Gillett Reduction Company, Cripple Creek; and vice-president and general manager, Metal Volatilization Company, Denver. About 1915 he went to California to superintend operations of the Carson-California Mining Company, which he had promoted in Denver for the development of property adjacent to the Melones mine, on Carson Hill, near Angels Camp. Mr. Hawkins was widely known among mining men of the West.

▼ ▼ ▼

A LETTER

Institute of Geology Founded in Venezuela

The Editor:

I THINK it will interest your readers that a Geological Institute has been founded in Caracas, Venezuela. The Instituto de Geología was formally opened on Sept. 15, 1938, in the presence of President López Contreras of Venezuela. Classes began that day with a registration of 24 selected students.

The Institute is fully equipped for the training of students in the fields of general geology, petroleum geology, and mining geology. It is housed in its own building, which contains a large lecture hall, several recitation rooms, separate laboratories for chemistry, mineralogy, petrography, paleontology, and economic geology, a drafting room, a research laboratory for the staff, a preparation room for the cutting, grinding, and polishing of specimens and thin sections, and a workshop. Also included in the Institute are a paleontologic museum and a large library. All the laboratories are equipped with the latest apparatus for the investigation of geologic problems.

In addition to courses in mineralogy, economic geology, petroleum geology, paleontology, stratigraphy, sedimentation, field geology, and related subjects, basic courses in chemistry, physics, botany and zoology, mathematics, drafting, hygiene, mining and petroleum laws, and language are given. The Institute also has its own physician, who, in addition to his medical duties, will teach hygiene.

The Institute as at present constituted will give a bachelor's degree in geology at the end of four years' study, half of the fourth year being spent in the field. It is planned, later on, to extend the scope of the Institute so as to be able to grant higher degrees.

Though the Instituto de Geología is a part of the Ministry of National Education, it has been organized by a committee of professional geologists from the Ministry of Industries Geological and Mining Service. These men, trained in Europe or the United States, now form the Institute's Board of Regents. There are Drs. V. M. López (chairman of the board), M. Tello, P. I. Aguerrevere, Santiago E. Augerrevere, and G. Zuloaga. The faculty includes N. B. Knox, technical director and professor of geology; Ely Mencher, professor de paleontology; Bela Muracosy, professor of topography; Hermann Kaiser, professor of chemistry.

There are no tuition fees for Venezuelans at the Institute, but candidates must pass examinations in mathematics, chemistry, physics, biology, English, and French before being admitted. The course is four years and leads to degree. Six scholarships have been granted to students from other North and South American countries.

Many of the students are on scholarships provided by the oil companies operating in Venezuela, which give the student not only cash to live on but opportunity for field and laboratory work during vacations.

N. B. KNOX,
Director of the Institute
Caracas, Venezuela.

What Metal Statistics Show

ENTERING into the middle of the first quarter, the industry is carefully surveying prospects for improvement in the general industrial structure that will bring about the need of buying more metals. Sales of copper, lead, and zinc have not been active so far this year, and curtailment in output of some metals is already in effect. Anaconda Copper Mining Company announced closing of the Leonard mine on Jan. 17. Later in the same month D. D. Moffat, vice-president and general manager of the Utah Copper Company, announced production would be curtailed 10 per cent. President Louis S. Cates of the Phelps Dodge Corporation recently announced that production at the company's properties in Arizona would be curtailed to meet the present decrease in demand for copper by the company's consumers.

Domestic stocks of refined copper increased 20,267 tons in December, against a gain of 2,189 tons in November. Deliveries to consumers have steadily dwindled, being 38,853 tons in December, against 51,297 tons in November and 69,827 tons in October. Estimated consumption of copper in November was 52,000 tons, and for December 33,000 tons. The current rate is estimated around 39,000 tons.

Though business has been quiet, some in the industry continue to hold firm views on a satisfactory outlook for the year.

The Copper Institute's figures for November and December, in short tons, follow:

	Nov.	Dec.
Production, crude:		
U. S. mine	60,235	60,683
U. S. scrap, etc.	12,728	11,112
Foreign mine	112,569	106,559
Foreign scrap	13,318	16,033
Totals	(a)198,850	194,387
Production, refined:		
U. S. duty-free	66,746	67,947
Foreign	111,064	121,854
Totals	177,810	189,801
Deliveries to customers, refined:		
U. S. domestic	51,297	38,853
U. S. exports (b)	13,260	8,827
Foreign	113,427	109,490
Totals	117,984	157,170
Stocks at end, refined:		
United States	269,488	289,755
Foreign	155,049	167,413
Totals	424,537	457,168

(a) Revised. (b) Duty-free copper.

The statistics of the Copper Institute, covering between 85 and 90 per cent of the world's production of copper, are summarized in the following table for 1937 and 1938, in short tons:

	1937	1938
Production, crude (a):		
United States (b)	982,045	643,346
Foreign	1,349,138	1,295,326
Totals	2,331,183	1,938,672
Production, refined:		
United States (b)	964,176	637,485
Foreign	1,301,873	1,299,544
Totals	2,266,049	1,937,029
Deliveries:		
Domestic	803,095	481,229
U. S. Export (b)	62,798	125,852
Foreign	1,282,284	1,343,975
Totals	2,148,177	1,951,056
Stock at end, refined:		
United States	259,351	289,755
Foreign	211,844	167,413
Totals	471,195	457,168

(a) Smelter production and custom intake, including scrap; figures do not include Russia, Japan, Australia, and some miscellaneous production. (b) Duty-free, or chiefly copper of domestic origin.

Exports of refined copper from the United States (foreign metal refined in bond and domestic material) amounted to 370,545 short tons in 1938, against 294,279 tons in 1937. The exports, by countries of destination, were as follows:

To:	1937	1938
Chile	57	15
Belgium	14,639	9,173
Czechoslovakia	5,334	33,415
Denmark	3,550	1,294
France	39,196	32,110
Germany	37,259	74,334
Great Britain	52,791	30,616
Italy	20,657	21,875
Netherlands	7,485	6,891
Poland and Danzig	3,671	12,457
Sweden	17,363	18,623
China and Hongkong	6,758	3,335
Japan	72,843	109,990
Africa	.....	2,501
Other countries	12,676	13,916
Totals	294,279	370,545

▶ ZINC—Stocks of common grades of zinc increased 1,699 tons and High Grade 4,127 tons during December. Shipments in January are expected to be around 17,000 tons, and even though there was curtailment in production during January, producers anticipate another increase in stocks for that month. The rate of galvanizing has been holding to satisfactory levels, but the depressing influence in the zinc industry of the lower cut in the zinc tariff continues to obscure the outlook.

E & M J Weighted Index of Non-Ferrous Metal Prices

(100 is composite for 1922-3-4)

1929	110.33	1934	69.56
1930	82.87	1935	74.66
1931	60.20	1936	73.45
1932	48.26	1937	90.86
1933	59.79	1938	73.67

	1937	1938	1939
January	87.03	75.56	77.12
February	91.68	73.43	....
March	103.78	72.41	....
April	98.62	71.19	....
May	93.25	69.15	....
June	93.21	67.55	....
July	93.82	72.95	....
August	95.28	73.94	....
September	94.33	74.70	....
October	85.26	77.61	....
November	78.91	78.36	....
December	75.18	77.13	....

The record for 1938, by months, for all grades, in short tons, according to the American Zinc Institute, follows:

	Production	Shipments	Stock At End
January	48,687	24,931	89,089
February	41,146	22,097	108,138
March	43,399	33,528	118,009
April	38,035	20,806	135,238
May	37,510	24,628	148,120
June	30,799	29,248	149,671
July	30,362	33,825	146,208
August	32,296	36,507	141,997
September	32,328	43,582	130,743
October	36,740	43,355	124,128
November	40,343	43,693	120,778
December	44,825	38,999	126,604
Totals, 1938	456,470	395,199	
Totals, 1937	589,619	569,241	
Totals, 1936	523,166	561,969	
Totals, 1935	431,499	465,746	
Totals, 1934	366,933	352,663	

The Prime Western division's production for December was 19,633 tons, making a total for the year of 219,563 tons. Shipments of that division of the industry amounted to 17,934 tons in December, making the total for the year 199,895 tons. Stocks of zinc held by the Prime Western group as the year 1938 ended totaled 49,002 tons, which compares with 29,334 tons on Dec. 31, 1937.

▶ LEAD—The increase in lead stocks during December was less than the industry anticipated. Production dropped more than expected, and the increase in refined lead was only 768 tons.

The November and December figures on refined metal compare as follows, in short tons:

	Nov.	Dec.
Stock at beginning	117,476	115,134
Production:		
Domestic ore	35,958	30,988
Secondary and foreign	3,715	3,695
Totals	39,673	34,683
Domestic shipments	42,005	33,908
Stock at end	115,134	155,902

The figures for the years 1937 and 1938 were as follows:

	1937	1938
Stock at beginning	171,856	129,131
Production:		
Domestic ore	497,408	381,849
Secondary and foreign	35,807	26,690
Totals	533,215	408,539
Domestic shipments	575,933	421,625
Stock at end	129,131	115,902

150th Meeting A.I.M.E.

▶ Members of the American Institute of Mining and Metallurgical Engineers will meet at the 150th meeting in New York City, Feb. 13-16, to discuss problems and progress in many phases of the mining industry. Sessions on mining methods, trends in blasting, mill practice, and the All-Institute session at which Tom M. Girdler, president of Republic Steel Corporation, is the speaker, will feature Monday's program. Tuesday's sessions will include discussion of ore flotation, grinding, and mining geology. Other technical papers will describe drilling, detachable bits, and economic geology and treatment of important industrial minerals.

The dinner-smoker will be on Feb. 13 and the annual reception and dinner will be held on Feb. 15, both at the Waldorf-Astoria Hotel. President D. C. Jackling, toastmaster, will present the Williams Saunders Gold Medal to Louis Shattuck Cates, and the Robert H. Hunt medal will be presented to Kenneth C. McCutcheon and John Chipman, and Donald B. Gillies, the president for 1939, will be introduced.

CALIFORNIA

Idaho Maryland Mines Leaves Forbestown

Operations are suspended due to failure to develop sufficient ore of satisfactory grade—Shaft sinking completed at Kennedy mine—Several mines resume production and development

▶ Idaho Maryland Mines Corporation has ceased operations at Forbestown, in Butte County, Calif., after a thorough reexamination of conditions there. The original development was undertaken on the basis of assays of a considerable body of low-grade ore at the Midas mine, which seemed from the reports of the engineers to justify the erection of a mill at the Midas. Development work was to be pursued at the Gold Bank and other mines in the district during extraction at the Midas. Unfortunately for the outcome, the Midas failed to produce any substantial amount of ore of milling grade, and after thorough tests and unprofitable operation for some months, work on the Midas was shut down about a year ago, and the company devoted its entire attention to the Gold Bank group. Though the ore was of better grade there, the operation failed to develop a sufficient quantity of profitable ore to warrant milling at the Midas site or the removal of the mill to the Gold Bank. It was the unanimous opinion of the management and the board of directors of the company that operations at Forbestown should be abandoned, and that the company's activities be confined for the present to the Grass Valley district, where the developments continue to be consistently satisfactory.

▶ The shaft-sinking work started a few months ago as a preliminary to developing an orebody discovered on the 5,500 horizon in the Kennedy mine, at Jackson, Amador County, has been completed, and the exploratory drift started on the 5,700 level has been advanced more than 100 ft. Deepening of the main shaft to a point below 5,700 ft. involved sinking a distance of 300 ft. The 1,500-ton cyanide plant, about a mile from the mine and which is treating accumulated tailings, is operating at capacity, though the available material is expected to be exhausted soon. E. C. Hutchinson is president of Kennedy Mining & Milling Company, with William Sinclair, superintendent, in charge of the mine, and Murray N. Colman, metallurgical engineer, directing the work at the tailings retreatment plants.

▶ The McAlpine mine, near Coulterville, Tuolumne County, was recently acquired by W. A. Hayes, of San Francisco, who plans to rehabilitate the property, idle since 1918. Mineral holdings extend some 2,100 ft. on the Mother Lode, and the mine is opened by a shaft 670 ft. deep. Hoisting and compressor units are available, and electric power is to be brought in by a 4½-mile cable, to be installed.

▶ Diamond drilling, expected to extend over several months, is in progress at the Spring Hill mine, a short distance from Grass Valley, Nevada County. The property is equipped with a modern 100-ton flotation mill and an extensive surface plant. Operations are directed by C. C. Cushwa, general superintendent.

▶ The Calmich Mining Company, controlled by Mack C. Lake, consulting geologist, 74 New Montgomery St., San Francisco, has taken a lease on the Blue Point gravel mine located near Smartville, Calif. James R. Elmendorf is superintendent in charge of operations. The officers of the company are Mack C. Lake, president and treasurer, Carlo S. Morbio, secretary. The mine will be worked by underground drift methods, using double-drum slusher hoists and scrapers. Cemented gravel will be disintegrated in a cylindrical mill and trommel. Gold occurring in the undersize material will be recovered in a Pan-American Pulsator jig, supplemented with sluice box riffles. The oversize tailings will be sluiced into a bin where they will be drawn into a dump truck for transportation to the dump pile. Production is expected to equal about 100 tons of gravel per day.

▶ Humming Bug Mines Company, Yreka, Siskiyou County, has placed in operation the new 50-ton cyanide plant completed recently by Western Knapp Engineering Company. Equipment includes a ball mill, classifier, seven leaching tanks, and auxiliaries, and power is furnished by two small diesel engines. The company is headed by C. S. Haley, of Berkeley, with Joseph T. Buell, superintendent, in charge of the property.

▶ The 170-ft. shaft at the Mack mine, near Nevada City, Nevada County, has been unwatered, and further sinking is in progress under the direction of J. L. Jackson. The property is held under option by the Arizona California Exploration Company.

▶ P. C. Sacchi and E. L. Spellenberg, of Arcata, Humboldt County, have completed the installation of a dragline dredge assembly at Salmon Forks, Siskiyou County. The unit consists of a 1½-yd. Link-Belt dragline and a Judson-Pacific Company floating washing plant capable of handling 3,000 yd. of gravel a day.

▶ The Sixteen-to-One Extension Mines, Inc., Alleghany, Sierra County, after a temporary shutdown, has resumed development work under the direction of George W. Hallock, president and general manager. Preparations have been completed to continue work throughout the winter.

▶ Operations have been resumed at the Union mine, recently leased by Chez Martin, of Plymouth, Amador County. The property is about 12 miles from Plymouth, and at the available mill ten stamps are now in operation, with the other ten to be put to work soon. Some dump material is said to be of milling grade.

MONTANA

Anaconda Copper Curtails Copper and Zinc Output

Leonard mine, at Butte, closed and operations of two zinc units at Washoe plant suspended—Montana Commission reports low dust count found in butte mines

▶ In mid-January, in response to a slackening in copper metal buying, the Anaconda Copper Mining Company announced the closing of its Leonard mine, at Butte, on Jan. 17. This step in curtailment will affect approximately 1,000 employees. No further curtailment plans in copper have been announced, but will probably be dependent upon analysis of January production and buying statistics. On the same day two units of the Washoe zinc plant were also closed.

▶ A report of the Montana Commission for the Study of Occupational Diseases was submitted to the Legislative Assembly on Jan. 9. Referring to the dust hazard, so frequently associated with mining, the report stated that United States Bureau of Mines dust count in Butte mines shows a reduction to 2,200,000 particles per cubic foot since wet drilling and other improvements were put into effect. Studies by the United States Department of Labor in-

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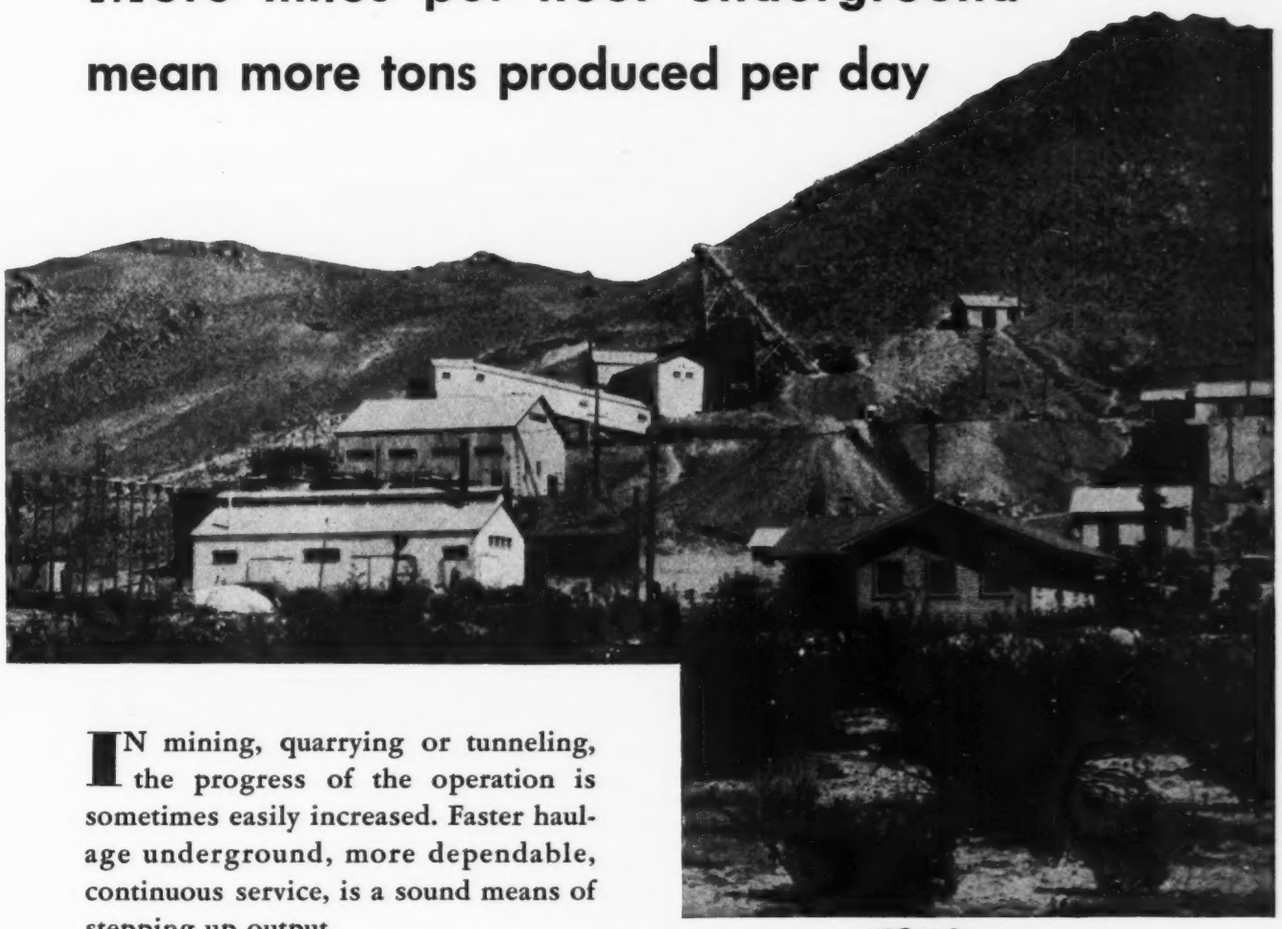

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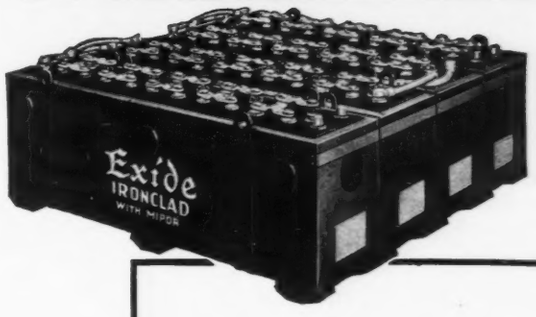

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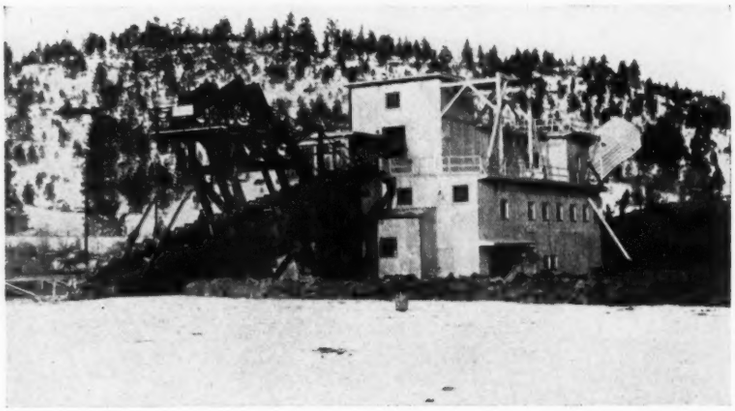


The new Winston Bros. gold dredge on Prickly Pear Creek, Montana. This 5½-cu.ft., bucket capacity dredge is equipped with jigs and was largely responsible for holding the State's gold production up in 1938

▶MONTANA

dicate that a dust count of 5,000,000 particles of silicoic materials represents the danger point. The report states: "These matters, together with the fact that the records at Galen disclose that no one afflicted with silicosis has entered that institution with a mining record which began since wet drilling was put into effect, convince the majority of your commission that the vast sums of money expended for the elimination and control of dust in Butte mines have produced safe working conditions, and that the silicosis hazard has been eliminated."

▶ The annual meeting of the Montana section of the American Institute of Mining and Metallurgical Engineers was held at the Finlen hotel on Jan. 16. Guests at the meeting included the membership of the Montana Society of Engineers, G. G. Griswold, Jr., president, and members of a group of students from the University of Witwatersrand, Johannesburg, South Africa, led by Dean C. W. Biccard-Jeppe, who gave an address on "The Romance of Gold in the Transvaal." A. D. Falk, Jr., of the Anaconda geological staff, discussed modern developments in the glass industry. Before the close of the meeting, Dr. C. L. Wilson president of the section during the past year, inducted A. S. Richardson into that office for the coming year.

▶ In co-operation with the State Bureau of Mines and Geology, the Montana School of Mines of the University of Montana offers several research fellowships and graduate assistantships in geology, metallurgy, mining, and mineral dressing. These fellowships and assistantships are open to college graduates who have had good scientific training in those sciences which are the foundation of the mineral industry, and who are especially qualified to undertake research work. Applications should include a certified copy of college record, a statement of professional experience, and a recent photograph. The applicant should also have letters of recommendation sent by three qualified persons and must be received by April fifteenth, 1939. A. M. Gaudin, is chairman, Graduate Committee, Montana School of Mines.

ARIZONA

Molybdenum Property To Be Reopened

Shaft of Telluride Chief mine will be dewatered—Tungsten mine near Arivaca may soon resume operations—Keystone Divide Mining Corporation takes over Oatman Gold Center mine

▶ The Telluride Chief property, in the Hualapai Mountains, about 20 miles southeast of Kingman, has been optioned to California interests and unwatering of the old 400-ft. shaft will be started at once. This property shut down soon after the signing of the World War armistice. The owners, Walter Meyer and his associates, have been shipping quantities of molybdenum ore for the past two years. The ore also contains gold and silver, and some tungsten.

▶ It is reported that work is to be resumed at an early date at the Las Guijas tungsten mine, near Arivaca, by the General Electric company.

▶ A 25-ton milling plant equipped with 6-ft. Huntington tables is being installed at the Albatross mine, near Arivaca, under the direction of William T. Plum, Jr., superintendent for the Albatross Gold Mines, Inc.

▶ The Lucky Strike property, near Alamo, is being developed by a crew of three men. The mine is owned and operated by J. A. Benedict and associates of Aguila.

▶ Dean Hogue, operating in Music Mountain, in the old Music Mountain camp 20 miles northwest of Hackberry, has been making regular shipments of good gold ore to the Vivian mill, at Oatman. Sub-leasers on the property have been finding excellent values. This district 50 years ago had considerable publicity because of the high-grade gold ores that were found by the early prospectors.

▶ Amalgamated Mining & Smelting Company, J. Von Ross, president, North Fourth Ave., Phoenix, is shipping two cars of ore per week from the Belmont mine, in the Salome district. Seven men are employed.

▶ Golden Relief Mining company is doing development work on the Fred Walters and the Dempsey Powell properties, located about 10 miles north of Aguila. Ten men are employed. The Powell property is being equipped with compressor and drills. The ore contains gold, silver and copper.

▶ Gold and copper ore is being mined for shipment at the property owned by Kerney Moore, of Aguila. It is 6 miles south of Aguila and is owned by J. E. Thompson, of Aguila.

▶ Claude and Bert Clay, of Arivaca, are operating under lease the property of the Back Bone Mining company. Ore shipments are being made steadily from the development work now in progress. The Back Bone Company is headed by Houston L. Walsh, of Phoenix.

▶ A 300-ft. crosscut is being driven from the 300-ft. level of the Vision Point mine, near Pearce, for opening up ore previously disclosed by diamond drilling. General Manager H. N. Carleton is in charge of operations, which are controlled by H. F. Potts of Shawnee, Okla. The values are in gold and silver.

▶ The Hilltop silver, lead, zinc mine at Hilltop, Ariz., has recently been taken over by J. H. Blackwell. Ore is shipped to the El Paso smelter and it is planned to install a mill soon.

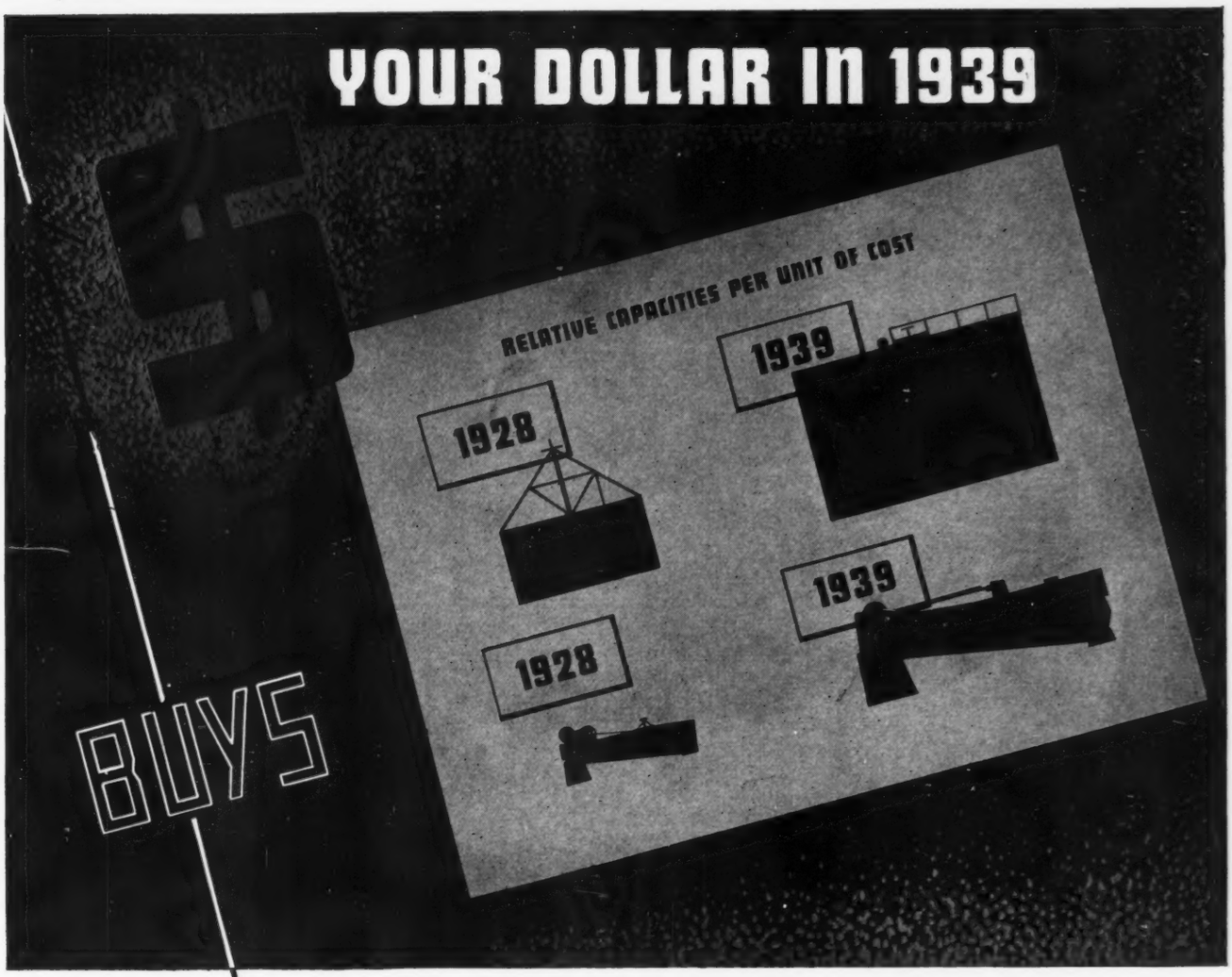
▶ The Jakescheer mine, near Alfreda, has a crew of men working under the direction of Ralph Schupbach, who holds a lease on the property. The ore contains lead, tungsten, and vanadium, which is being treated by table concentration in a 15-ton capacity milling plant.

▶ A 10-ton test plant is being installed about three miles north of Wilcox by Joe Woods, of Wichita Falls, Tex. The new plant will test a process using a combination of heat-treatment with Butane gas and leaching.

▶ The Apex and Wood property, near Winkelman, is operated by Thomas J. Anderson, of Hayden Junction. He is shipping three carloads of gold-silver ore per month. The property is owned by Fred Muller of Los Angeles, and Thomas Quarelli, of Winkelman.

▶ The Grand Reef mine, near Klondyke, is producing approximately 150 tons of lead, silver and copper ore per month. The property is under lease to Joseph A. Gruwell, of Klondyke, and who expects to double production soon.

▶ Veta Mines, Inc., is treating approxi-



43% More Dorr Thickener Capacity *and* 67% More Dorr Classifier Capacity than in 1928

Today each dollar spent for a modern Dorr Thickener buys 43 per cent more sedimentation capacity than in 1928.

Likewise each dollar spent today for a modern Dorr Classifier buys, on the average, 67 per cent more sand raking capacity than eleven years ago.

These comparisons are based on the 1928 and 1939 prices of six sizes of thickeners, ranging from 10 feet to 80 feet and of four widths of classifiers, ranging from 3'0" to 8'0".

Comparisons are made solely on the basis of cost per ton of capacity, with no weight whatsoever given to eleven years of refinement in design which represent additional value.

Dorr policy is not a policy of cutting prices but one of lowering the cost to the user by making a dollar's worth of machine do a bigger and better job.

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ARGENTINA: Luis Fiore, Buenos Aires • SOUTH AFRICA: Edward L. Bateman Pty. Ltd., Johannesburg • BRAZIL: Oscar Taves & Co., Rio de Janeiro

▶ARIZONA

mately 200 tons per day in its flotation plant at Ash Peak, 12 miles west of Duncan. About 100 men are employed. Herbert A. Lines, of Duncan, is superintendent. The values are in silver. No development work is now being done. The Veta Mines are also operating the Carlisle property, 16 miles east of Duncan just across the New Mexico line.

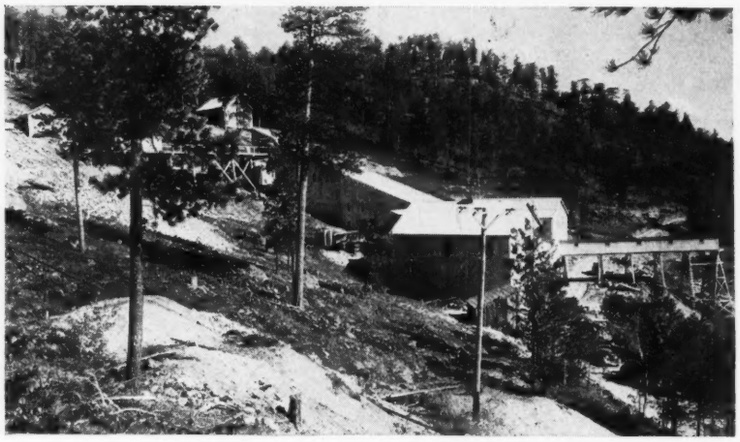
▶ The Greenlee Gold Mountain Mining Company, near Clifton, is preparing to drill for bedrock on the San Francisco River for a proposed diversion dam. A 900-ft. tunnel is also being driven to cut the lower horizon of developed ore on its property.

▶ The Oatman Gold Center property, adjoining the Vivian mine and mill near Oatman, has been taken over by the Keystone Divide Mining Corporation, a new company with C. R. Watkins, president, of 210 West Seventh St., Los Angeles, Calif.; Frank Warning, of Oatman, vice-president; and A. B. Dorman, Los Angeles, secretary. A 72-ton shipment from the property gave returns of $29 per ton in gold. The ore from the property will for the present be milled at the Vivian mill.

▶ The Eagle group of claims in the Cerbat range 15 miles north of Kingman are being operated by Joe Lee and Dan Hill. About 200 tons of gold-silver ore have been trucked to the Vivian mill, at Oatman, for treatment and twelve carloads have been shipped to the El Paso smelter. A hoist and compressor are being placed on the property.

Mines Bureau Creates Secondary Metals Section

▶ A new section to deal exclusively with secondary metals has been created within the Bureau of Mines. Headquarters will be at Pittsburgh, and James S. Earle will be supervising engineer, according to an announcement by Dr. John W. Finch, Director of the Bureau. This move was necessitated by the constantly increasing importance of scrap as a factor in metal supply and by the growing demand upon the Bureau of Mines for authoritative information in this field. Bureau officials have long recognized that the stock of metals in use and the scrap returning to industry constitute a great national resource, and that the formulation of a sound public policy with respect to raw material supply is dependent upon a thorough understanding of the secondary metal problem. Not only is the scrap industry itself in need of more frequent and detailed data than have heretofore been available, but the rapid growth of secondary metal production is exercising a profound influence on mining which is too little understood by reason of insufficient data. In the light of these facts, Dr. Finch pointed out that a thorough knowledge of the extent and industrial incidence of secondary metal production was highly essential to the regular flow of current supplies as well as to the effective conservation of irreplaceable natural resources. Although annual statistics on the production of secondary metals of the non-ferrous group have been compiled over a period of thirty years, it is only now that funds have become available for regular coverage of the vast resources of ferrous scrap that annually return to the industrial cycle.



Gilt Edge group of mines and mill in South Dakota worked its first full year in 1938. The plant, equipped in 1937, helped to increase the State's gold production last year

UTAH

Utah Copper Company Curtails Output

Production running in excess of demand for metal forces drop in operating schedule—Tooele Smelter goes from five to six-day week—Good progress being made at Elton Tunnel

▶ Utah mining activity has its bright as well as its dark spots. Although the Utah Copper Company, because of reduced sales, was forced to cut production 10 per cent, throwing about 350 men out of employment, the International Smelting & Refining Company plant at Tooele went from a five- to a six-day schedule.

▶ Labor developments were favorable. On Jan. 15, Manager William J. O'Connor of the American Smelting & Refining Company announced the signing of a pact with the International Union of Mine, Mill and Smelter Workers governing the Murray and Garfield plants, granting the union recognition for collective bargaining purposes. The agreement established certain seniority rights for employees and set up a permanent arbitration council composed of management and worker representatives.

▶ At the Bingham, Lark, and Midvale properties of the United States Smelting, Refining & Mining Company, the announcement of International Union members that they would refuse to work with non-union colleagues gave such an impetus to the unionization compaign that union leaders the next day reported a near 100 per cent enrollment. Company officials did not intervene. They took the position that the disputes concerned employees only. Work continued without interruption.

▶ The increase in operations at the Tooele smelter of the International Smelting & Refining Company resulted from the increased production coming from the company's new Ophir mill. This plant, recently completed at a cost of $125,000, is being used to treat the tailings dump of the old Ophir Hill Con mine. The capacity is 600 tons daily. Employment at the smelter totals about 450 men.

▶ Reduction of Utah Copper mine output brought a curtailment at the Magna and Arthur mills of the company. About 3,000 men are employed by the company at its mines and mills. Employment at the Garfield smelter of the A.S.&R. was not affected.

▶ The Elton tunnel of the National Tunnel & Mines Company was cutting through a gravel-clay formation 6,300 ft. from the portal at the last report from Tooele. Four shifts are being employed continuously. Progress in the 9x11 ft. tunnel is averaging 30 ft. daily. In a distance of 2,000 ft. more, the company hopes to enter bedrock located by churn drilling. Ingersoll-Rand drills, Finlay No. 2 loaders, and Baldwin-Ajax electric locomotives of the combined storage battery and trolley type are used.

▶ A compressor house, a bunkhouse, and a blacksmith shop have been built at the East Stock Consolidated Mining Company's property of fourteen claims, three miles east of Stockton. The tunnel is being advanced in the formation at a point about 2,200 ft. from the portal. C. A. Harker is president of the company, Ed. M. Shea, vice-president, Louis Gruenig, secretary, and Gordon McMillan, geologist.

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STURDY

NEWS FROM Washington

By Special Correspondent

MINERAL STOCKPILES for military preparedness are near the top of the list of Washington urgent questions. Probably the Army and Navy in their planning would make the request for such mineral reserves second only to the extremely urgent need for additional aircraft.

Unfortunately, some other folks in Washington do not appear to regard this question as quite so important. Proponents of a proper program are hoping, therefore, that the industry itself will get to work and force needed attention for this subject in high places where the thinking is "laggard or indifferent."

Also urgently needed is considerable clarification of the question whether these mineral stockpiles will be built at low cost in order that the supplies may be the largest possible with a given money expenditure, or whether domestic mineral politics will be allowed to raise the average price to the Government. This, naturally, is a most delicate subject. It is elaborated a bit below.

What Is "Strategic"

FOR A LONG TIME changes have been occurring in the desirable definition and listing of those commodities which, for Army and Navy reasons, must have first or second attention. It is particularly important, therefore, for the mining industry to note the new list issued Jan. 7, 1939 with the approval of the Army and Navy Munitions Board. On page 105 are listed these commodities, not only those of mineral nature, but also other industrial materials interesting to the mining industry for sake of comparison.

It will be noted that of the 17 "strategic" materials 11 are of mineral origin. Out of the 20 "critical" materials 10 are of mineral nature, or products of mineral industry. Of the third list of 35 "essential" materials, 16 are of concern to the mining and mineral industries. All this shows the tremendous importance of these industries in the preparedness program.

Cost of Preparedness

TWO PRINCIPAL BILLS have been introduced into Congress as a basis for discussion of the stockpile program. A casual comparison of these shows that they contemplate much the same general plan. But close analysis discloses important differences that seem on the surface "only minor in nature," and are likely to be so called. The mining industries are being urged, therefore, critically to study these differences. One is the Senate bill S.572, introduced by Senator Thomas, of Utah, conforming to the recommendations of the interdepartmental committee and duplicating his measure in the last Congress. The second is H.R.2556, introduced by Representative Scrugham, of Nevada.

The Scrugham bill widens the proposals of the Thomas bill in phraseology, but many fear that it narrows the bill in meaning by frequently specifying "minerals, ores, concentrates, and alloys" instead of using the broader term "materials." It also adds a complicating factor by putting the Secretary of Interior into this control program with the Secretary of War and the Secretary of Navy. Most significant, it practically guarantees priority to domestic commodity regardless of relative cost. This latter feature, critics fear, will throw any purchase into the courts for indefinite wrangling, unless all the spending is done for domestic materials, a political consideration with which Mr. Scrugham is not unfamiliar.

The Thomas bill was prepared by an interdepartmental committee, as explained previously in these columns, with the single idea of getting mineral stockpiles of the necessary quality, in maximum quantities possible with the money available. Those who have prepared the bill know that the size of the stockpile will be much limited if unduly high prices must be paid for domestic material under the guise of giving American employment. They fear even more that the quality of the stockpile might be seriously depreciated if domestic materials get too much preference, for example in manganese.

Another interesting factor involved in all this discussion is the question as to whether preparedness will be limited by fallacious bookkeeping. Take this example: Suppose manganese were brought in duty free at the world price and put into the stockpile to be owned by the Government. The cost would be not over two-thirds that which would result if the full duty must be added when the mineral is imported. (Of course purchase in the domestic market would also make the material more expensive.) The duty collected would go into the Treasury and thus safeguard the taxpayers; but if the duty has to be taken out of the limited funds appropriated for purchase of stockpiles, it means that only two tons of manganese will be there, instead of three tons which could have been purchased under a different bookkeeping system, with precisely the same money cost per ton.

New Resource Estimate

SELDOM has Washington seen an attack on a mineral industry turn so completely into a boost and a justification as happened recently. The target, and beneficiary, was the phosphate-rock industry. The case went something like this:

Phosphate-rock miners had a justifiable case of jitters when the President announced last March that he was going to recommend an investigation so that this industry could be stopped from exporting an essential and limited resource. He kept his promise in late May with a message to Congress. A Senate committee, headed by Mr. Pope, of Idaho, was appointed. Hearings were held in Idaho, Tennessee, and Florida. The results, significant for much of the mining industry, are just now coming out.

The Phosphate Rock Institute renewed its activities and really did a fine new job of resource exploration. Most of the important areas held by the industry were core-drilled, or otherwise explored. A remarkable and completely persuasive summary shows that instead of 200 years' reserves, as ordinarily estimated, this industry has at least 5,000 years' reserves, even if measured by the maximum probable use, in areas which the President thought were being rapidly depleted.

The great increase in reserve estimate comes from three things: (a) Better knowledge of underground conditions. (b) Better recoveries because of really modern mining and ore-dressing methods which are now applied. (c) The ability to use lower-grade materials, even materials of radically different mineral character, because of new furnace and utilization technics.

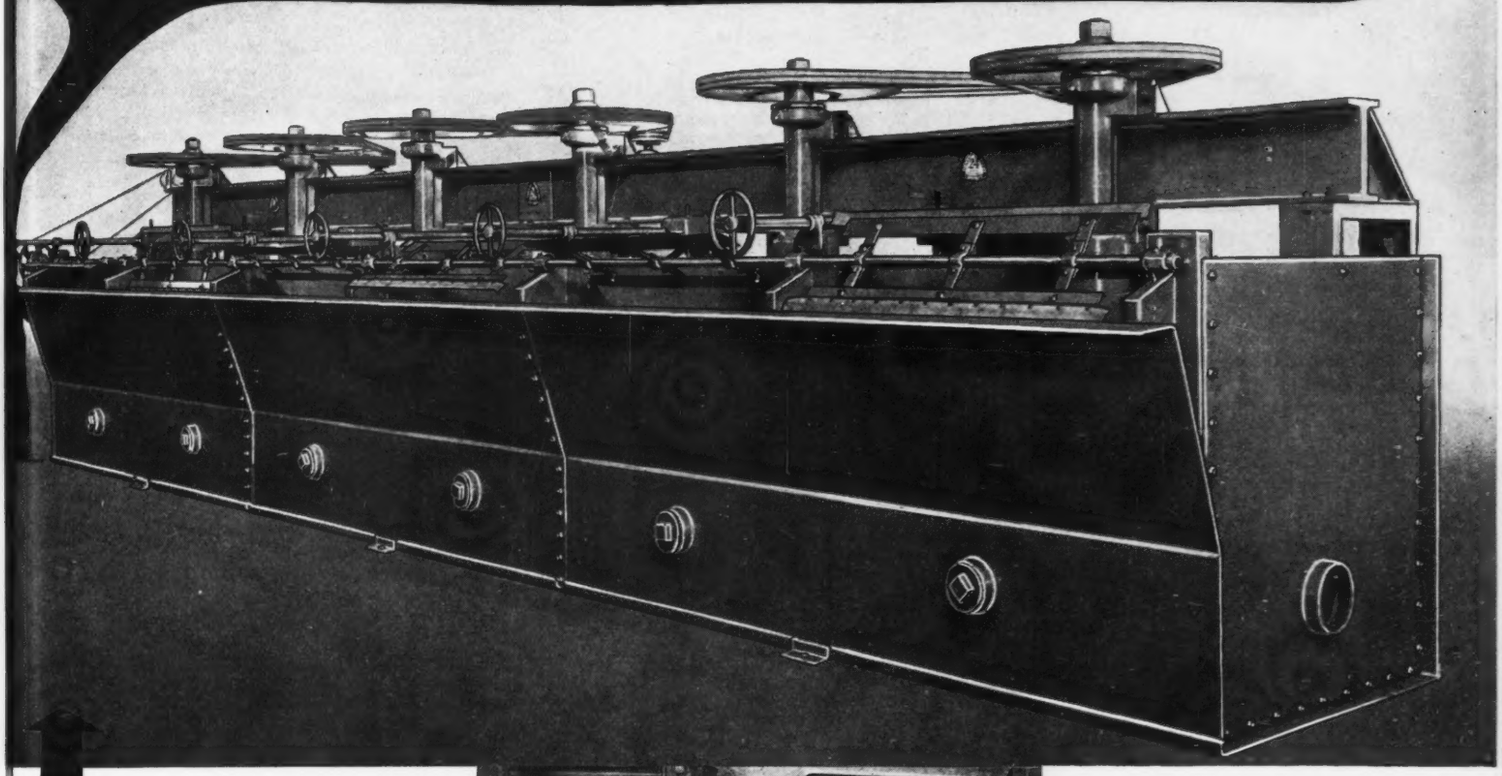
Senator Pope evidently "made good" on this investigation. He has been named to the Board of T.V.A. as a successor to Arthur E. Morgan. He goes there still an enthusiastic phosphate advocate. But his close friends say that he is now an admirer, not a critic, of the phosphate industry. This will be of great importance to the phosphate-rock industry of the whole country, and most especially to that in the Southeastern States.

New Technology

BOTH the Thomas and the Scrugham bills provide, as an an integral part, for new mineral-resource surveys by the United States Geological Survey and for new technologic research on methods of processing by the Bureau of Mines. The Thomas bill provides a total of $500,000 per year, with $150,000 of this for the Survey and the remainder for Mines. The Scrugham bill provides for twice as great a total, to be divided $250,000 for the Survey and $750,000 for the Bureau. Some folks are unkind enough to charge the Representative from Nevada with "raising the ante" in this fashion in order to enlist support of these important career agencies for new investigations to be done in his State.

Even these critics do not deny that these two important government units could spend this larger sum very efficiently, if political pressure were eliminated. But that is too much to hope for in the atmosphere of Washington. However these funds are allocated during the proposed four-year period of

3000 TONS OF ORE PER DAY WITH THIS DENVER "SUB-A" FLOTATION MACHINE LARGEST MECHANICAL TYPE UNIT BUILT



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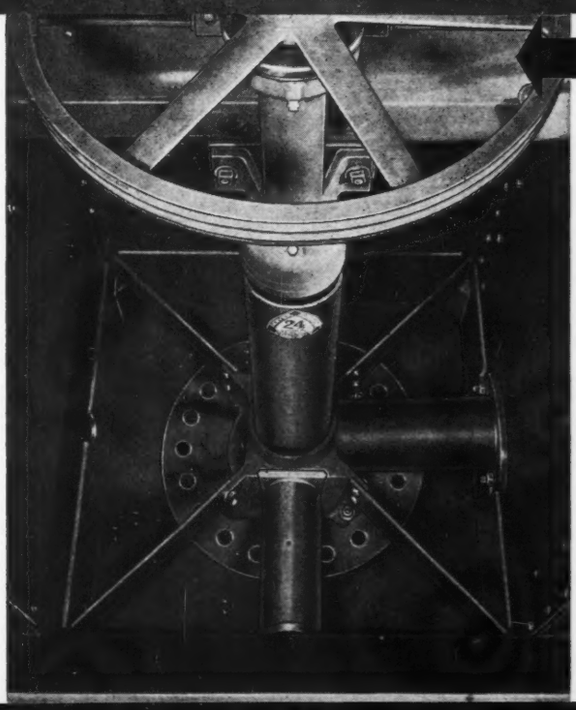
No application is too large, too difficult, or too complex for this No. 30 Denver "Sub-A" (Fahrenwald) Flotation Machine.

Now ***ONE*** Denver "Sub-A" will handle the pulp from several large grinding circuits, thus simplifying the flotation operation.

This No. 30 Denver "Sub-A" will handle 3,000 tons of dry ore at 40% solids down to 1,000 tons at 15% solids. The volume of each cell is 100 cubic feet, the largest of any mechanical type cell yet built.

Where large tonnages must be treated by a rougher machine at lowest cost . . this unit is ideal for such a plant. Wherever installed, the Denver "Sub-A" will give highest metallurgical efficiency per horsepower.



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The diffuser plate and impeller can be made of molded rubber having 6 to 11 times the life of hard iron. Rubber bottom liners and heavy metal side liners minimize interior cell wear.

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stockpile purchase, the sum spent on research and surveys will be small as compared with the wanted $100,000,000 which the Army and Navy are supposed to spend for goods.

There is, of course, no assurance that Congress will either authorize these appropriations by passing one of the bills discussed in the foregoing or actually appropriate the money. Many political slips are possible before the munitions planners get a drink of stockpile money.

Silver Delivery Date

DOMESTICALLY MINED SILVER may be delivered to a coinage mint not later than June 30 to qualify for 64.64c. per ounce. Or, as a matter of technical definition, the delivery may be accomplished "by the acceptance by a United States coinage mint on or before such date of a duly executed instrument of transfer on an approved form covering such silver." This means simply that the silver producer must make an estimate, and deliver what would be effectively a bill of sale before the deadline in order to meet requirements. He can put his silver in a basket and bring it around at any later convenient time thereafter, but that will not be "delivery."

This seeming distortion of the English language apparently is merely a means of meeting political pressure for greater extension of the silver policy without admitting that the President's proclamation of Dec. 31 was in error. Actually it means that silver is still the principal political metal of Washington. And this shining element is certainly a bright target for Administration critics, even for some critics within the Democratic party who have large influence on Capitol Hill.

It is anybody's guess whether the very real political need of the New Dealers for continued support in the West will be sufficient to hold "an extravagant bonus" on silver after June 30. Nobody yet knows, not even the folks who will have to make the policy in the early summer. But it is likely that some of the political logrolling involved will exhaust Administration promises that might otherwise have been used in other discussions on reform measures. Cynics allege a little comfort from this.

New Gold Plan

AMERICAN MINING CONGRESS has proposed a plan to prevent gold from being the forgotten metal. Essentially this scheme proposes the release of gold from its status of a nationalized metal so that citizens would have the right of private ownership of gold or gold certificates. Secondly, it proposes that the Government pay for gold at $35 an ounce in gold coins or gold certificates.

The whole thing would merely reestablish gold as a common coinage commodity, not merely a theoretical monetary standard. The purpose of Mining Congress is principally to get the gold back into circulation in the United States, and perhaps even to achieve a re-export of gold so that the world's reserves of this coinage metal might be distributed more nearly in proportion to the needs of the various industrial nations.

Opposition to any such plan can be expected on the part of those who believe it inflation. It is a question, therefore, whether the gold State senators will want such release of gold from the Kentucky vaults badly enough to fight for such a change in monetary policy. And it may be hard to prove to them that gold is actually in danger of being made into a common metal with no value other than that which comes from its intrinsic industrial usefulness.

Certainly no early action on the A.M.C. proposal need be expected. A long program of education lies ahead, if any such plan is ever adopted while the New Deal is in power.

Secondary-Metal Studies

THE ENLARGED WORK of the Bureau of Mines dealing with secondary-metal statistics and economic problems has been definitely advanced by the formal appointment of James S. Earle as supervising engineer in charge of this work at the Pittsburgh station of the Bureau. The rapidly increasing importance of secondary metal recovered from scrap has necessitated new emphasis on this subject. The Bureau leaders believe that it is now time to regard scrap, and other metal which may be recycled by industry, as a great metal resource. Those marketing primary metals already realize that this old material which returns to the markets from the scrap heap is oftentimes an important limiting factor on the whole sales policy of an industry. It is hoped that the new investigations will be sufficiently comprehensive in their statistical scope to furnish a guide to those engaged in both primary- and secondary-metal marketing.

An interesting sidelight on the secondary-metal problem has developed in Washington lately in connection with military preparedness discussions. Some folks are urging that the best way in which to maintain a reserve of nickel in the United States would be to make this metal a more important item in our minor coinage. If pennies, nickels, and dimes were made of nickel, as would be technically possible, this metal alone would suffice as a war-time reserve, easily recovered by the Government for emergency uses, it is urged. The proponents of the policy apparently assume that oyster shells, or postage stamps, or other new tokens would have to be quickly substituted for this small change in an emergency. It is not likely that this proposal will go far, but it illustrates the potentialities of secondary metal, even in fields far removed from the scrap pile.

New "Fines"

No Suits Yet—Well after the middle of January the Wage-Hour Division of the Department of Labor had not been able to find any sufficiently serious cases on which to base suits for non-observance of the Wage-Hour Law. Administrator Andrews has a hard time to decide whether to be pleased at such complete compliance, or whether to be annoyed that he can't find a case by which the courts may clearly define the proper limits of the law and its enforcement.

More Trade Agreements?—There is no likelihood that the opponents of the reciprocal trade program of Secretary Hull can get anywhere with the proposal that no more such arrangements be permitted. The zinc industry, supported by several state delegations, is only one example of the reason why some restriction is urgently wanted by American business men. But there is a small possibility that such general opposition to some recent tariff cuts may be strong enough to require that future deals of this sort be approved by the Senate on the ground that they are treaties. But even that restriction would be defeated, as things now are in Washington, if the President opposed it as strongly as now seems likely.

Mexican Situation—The Mexican negotiations of Secretary Hull continue to progress very slowly. The major obstacle, other than the good neighbor policy, is the feeling that hemisphere defense is more important than property rights of defrauded American corporations and individuals.

Bad Wage Timing—An order of N.L.R.B. requires United States Potash Company of Carlsbad to reinstate a worker allegedly discharged for union activities. One of the official Board arguments criticizing the company policy is that "the company did not advance any explanation of its refusal to grant increases (in wage) until the employees formed an organization." Greeks bearing gifts are not only dangerous, but actually illegal, according to this ruling.

Pay as You Go—The President's proposal, that all military preparedness should be on a pay-as-you-go basis, is not taken too seriously by Washington observers. Such a virtuous hope is not a practical plan without abandonment of substantially all new developments other than a big Navy, already in the budget. The President has no fear of big deficits (witness the past ten years); and there is no reason to think that he will acquire any new timidity soon.

Mineral Appropriations—The Bureau of Mines and the United States Geological Survey will get a few thousand more under the budget for next year, beginning July 1, as things now appear. But, unless the mineral stockpile program passes Congress, there is no likelihood of any great change in scale or character of operations of either institution during the next fiscal year.

Labor Angles—The NLRB on Jan. 27 overruled protests of the A. F. of L. and certified the International Union of Mine, Mill and Smelter Workers (C.I.O.) as the exclusive bargaining agency for 1,122 employees at the Tennessee Copper Company, Copperhill, Tenn. On Jan. 9, the National Labor Relations Board dismissed a complaint against the United States Smelting, Refining & Mining Company, Bingham Canyon, Utah, alleging that it had interfered with and restrained its employees in the excercise of their right of self-organization.

Preparedness Materials

Definitions and Lists

Approved Jan. 7, 1939, by The Army and Navy Munitions Board

Strategic Materials are those materials essential to the national defense for the supply of which in war dependence must be placed in whole, or in part, on sources outside the continental limits of the United States, and for which strict conservation and distribution control measures will be necessary.

List of Strategic Materials (17)

Aluminum	Manganese (ferro grade)	Nickel	Quinine	Tungsten
Antimony	Manila fiber	Optical glass	Rubber	Wool
Chromium	Mica	Quartz crystal	Silk	
Coconut shell char		Quicksilver	Tin	

Critical materials are those materials essential to the national defense, the procurement problems of which in war, while difficult, are less serious than those of strategic materials because they can be either domestically produced or obtained in more adequate quantities or have a lesser degree of essentiality, and for which some degree of conservation and distribution control will be necessary.

List of Critical Materials (20)

Asbestos	Cryolite	Hides	Opium	Scientific glass
Cadmium	Flaxseed	Iodine	Phenol and picric acid	Tanning materials
Coffee	Fluorspar	Kopak	Platinum	Titanium
Cork	Graphite	Nux vomica		Toluol
				Vanadium

Essential materials neither strategic nor critical—In this classification are included those materials, essential to the national defense, for which no procurement problems in war are anticipated, but whose status is such as to require constant surveillance because future developments may necessitate reclassification as strategic or critical.

Essential Materials Neither Strategic Nor Critical (35)

Arsenic	Chlorine	Lead	Paper and pulp	Sulphuric acid (including sulphur and pyrites)
Abrasives	Copper	Magnesium	Petroleum	
Acetic acid	Copra	Methanol	Phosphates	
Acetone	Cotton linters	Molybdenum	Potash	Uranium
Alcohol (ethyl)	Helium	Nitrogen compounds (ammonia and nitric acid)	Refractories	Webbing and duck
Camphor	Hemp		Shellac	Wheat
Castor oil	Jute		Sisal	Zinc
	Iron and steel	Palm oil	Sugar	Zirconium

Industrial Survey Of 11 Western States

▶ Prospects for the development of electrolytic and other metal and non-metallic mineral recovery industries in the eleven Far Western states form one part of a comprehensive and exhaustive two-volume report on the industrial resources of that region to be printed in February by Industrial West, Inc., a non-profit cooperative organization established to compile data for use in exhibits at the Golden Gate International Exposition. The report will cover all phases of the industrial resources and markets of the Pacific Basin. It was prepared by a staff of experts under the direction of George W. Malone, former State Engineer of Nevada, at a reported cost of $135,000, with the cooperation of many State and Federal agencies and bureaus.

Treated in detail are industries which can be expanded in the region, including iron, ferro-alloys, zinc, manganese, chromium, aluminum, and non-metallic minerals. Included in the report will be sections dealing with development of Western manufacture, with trends in the amount, location, and kinds of manufactures now present; a general picture of the balance of trade of each State, with figures on net imports and exports for 157 commodity groups, and population growth and trends. Other sections discuss agriculture and the trend in land utilization, mineral resources both metallic and non-metallic, with extensive cataloging of ore deposits and mines; water resources, including detailed analyses of supplies together with laws relating to stream pollution; industrial fuels, with prices; present and potential electric power production; transportation facilities; forestry resources; fisheries; taxes affecting business; recreational advantages; labor conditions; and financial services. The entire report is to be profusely illustrated with tables, charts, maps and diagrams.

Because Industrial West, Inc., is not a publishing concern, the number of copies of the report to be printed will be gaged largely by the requests received in advance of printing. The two volumes will be available at a price of $15, which covers the printing cost only. If there is sufficient demand, separate sections of the report may also be made available. Inquiries should be addressed to Industrial West, Inc., 111 Sutter St., San Francisco, Calif.

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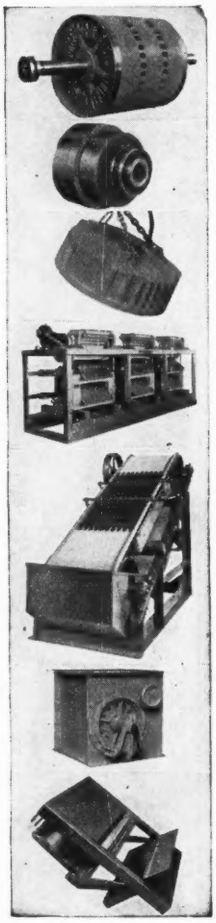

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IDAHO

Encouraging Developments At Several Mines

Good strikes made at Silver Summit, Liberal King, and Sunshine properties—Long underground connection will soon join Polaris and Sunshine mines—Clearwater Mining Company plans mill installation

▶ The Silver Summit mine, Coeur d'Alene district, reported an important ore strike early in January, according to President Harry P. Pearson, Wallace. The crosscut from the 600-ft. shaft level cut the vein which indicated a 17 ft. width, containing high silver, chalcopyrite and native copper. Drifting on the vein has started. Electric haulage is provided and mucking machines are employed underground. The Silver Summit main tunnel is being used jointly by the Polaris to transport ore from the shaft to the mill, a distance of more than two miles underground.

▶ A drift from the 1,900 level of the Polaris shaft is nearing a connection with a drift from the 900 level of the Sunshine mine. This will permit direct outlet through both mines and make possible a four-mile underground connection from the Sunshine to the Polaris mill.

▶ The shaft at the Coeur d'Alene Mines Corporation property will be extended an additional 400 ft. as fast as possible, for deeper development, according to D. E. Watson, secretary-treasurer, of Wallace.

▶ Enterprise Mining & Milling Company, Big Creek district, has resumed development operations under direction of Manager Fred Donaldson, Kellogg. The crosscut will be extended to the lead-silver vein, opened in the upper levels. Plans are under way to install power equipment.

▶ The Ada Elmore group in the Rocky Bar district of Elmore County has been leased for ten years by L. S. Breckon, of Bingham Canyon, Utah. A 1,000-ft. tunnel will be directed toward veins yielding high-grade gold ore in early days. A plant will be erected in the spring.

▶ Plans for a diamond drill campaign at the property of the King Solomon Mining Company in the Fourth of July Canyon are under way, and operations will start soon.

▶ The Liberal King mine, in the Pine Creek district, was the scene of an important ore find the week of Jan. 12. The strike was made in a drift from the 200-ft. shaft level. Manager Henry Weber, of Kellogg, reported the ore assayed 0.08 oz. of gold; 3.2 oz. silver and 12.6 per cent copper across 6 ft. The ore has been followed for 70 ft. A crew of twelve men are working on a two-shift basis.

▶ Development on the 3,100 level of the Sunshine mine, deepest operating level, is meeting with excellent results—eight feet of ore with an average silver content around 50 oz. per ton is being developed.

▶ Coeur d'Alene Mines Corporation has reelected Dr. Herbert Mowery, Wallace, as president; Dan Leary, Wallace, manager; Harry Groner, Jack Simpson and P. C. Scheable, directors; Dave Watson, Wallace, secretary-treasurer.

▶ Plans for increasing the production capacity of the Clearwater Mining Company operations at its Black Bird group, Grangeville district, are pending, according to W. H. Gains, Grangeville, manager. Plans call for installation of a 50-ton pilot mill to treat 18,000 tons of developed low-grade gold ore.

▶ Idaho's mining industry employed 6,500 men in 1938, it was reported by Arthur Campbell, state mine inspector. In spite of discouraging prices, said Campbell, employment remained fairly constant. Out of the total employed, 4,000 are working in the Coeur d'Alene district of north Idaho. Campbell said the Coeur d'Alene mines paid the highest wage scale of any mining district in the nation, with 1938 scales ranging from $5.75 a day for miners, $5.25 for muckers, to $6.50 for highly skilled laborers and $7.25 for shift bosses.

NEVADA

Court Authorizes Sale of Arizona Comstock Mines

Several properties held by company disposed of to Detroit interests—New 500-ton cyanide plant projected in Pershing County—Large capacity mill planned in Pioche district

▶ In the federal district court at Carson City, Judge Frank H. Norcross has authorized the sale to William N. Albee, of 2404 Eaton Tower, Detroit, for $720,000, of mine properties on the Comstock lode at Virginia City, formerly held by the Arizona Comstock Corporation under option of purchase from the Comstock Tunnel & Drainage Company. The transaction was concluded by James M. Leonard, head of the Comstock Tunnel Company and trustee in bankruptcy for the Arizona Comstock Corporation. Albee is president of the Consolidated Sierra Mining & Milling Corporation, formed to acquire the properties. Royal D. Gardner is vice-president and mines manager for the company. Changes in the flotation mill and completion of the 400-ton cyanide plant will provide plant capacity of 500 to 700 tons per day.

▶ Placer ground embracing some 6,000 acres of alluvial fans lying below the outlets of Copper Canyon and two other canyons 18 miles south of Battle Mountain, Lander County, and known as the Dahl-Christensen placer, has been acquired by James O. Greenan, formerly engineer for the Marsman Company in the Philippines.

▶ A statement received at Lovelock said that a contract had been awarded the Western Knapp Engineering Company,

of San Francisco, for construction of a 500-ton cyanide mill on property near Mill City, Pershing County, developed in late years by the Pacific Syndicate, controlled by Lindgren & Swinerton, San Francisco contractors, and acquired lately by H. L. Hazen, widely known metallurgist and head of the Caliente Cyaniding Company, operating a cyanide plant on old mill tailing at Delamar, in Western Lincoln County. A large tonnage of low-grade surface gold ore, developed by shafts and tunnels, will be mined by power shovel. J. Ross Frazer will be mine manager.

▶ Designs and estimates for a mill employing selective flotation and of 800 to 1,000 tons' capacity were said to have been submitted to officers of the Combined Metals Reduction Company, largest operators at Pioche, Lincoln County, controlled jointly by the National Lead Company and the Snyder group, of Salt Lake City. The mill is to be built at the Caselton shaft, from which a double-track crosscut is being driven over 4,000 ft. on the 1,000-ft level to connect with other productive workings. The Pioche district, notable for its production of lead, zinc, and silver, is supplied with power from Boulder dam. E. H. Snyder is manager at Pioche.

▶ A new shaft is being sunk on the Rip Van Winkle mine, 26 miles north of Elko and acquired lately by a group reputedly composed of officers of the Utah Copper Company. Large bodies of silver-lead ore of high mill grade, together with some ore of shipping grade, have been developed, and reports indicated a decision to construct a 100-ton flotation mill at the mine.

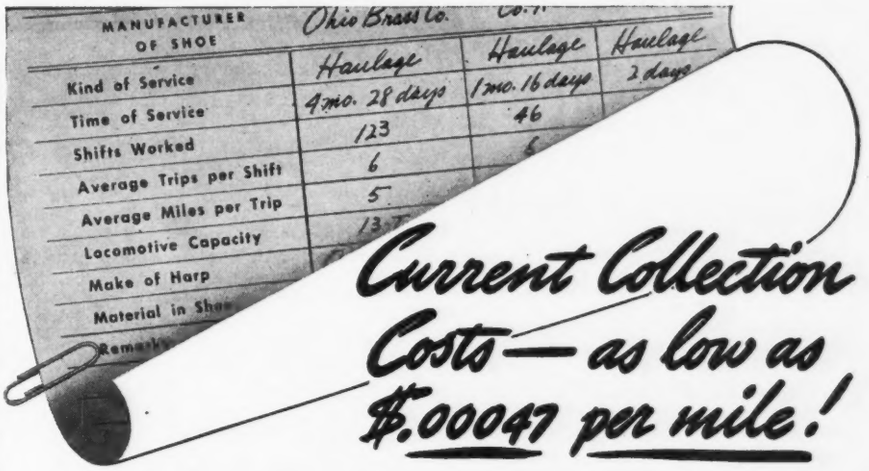
▶ Sampling of the formerly productive Lucky Boy silver-lead mine, 5 miles southwest of Hawthorne, in Mineral County, has been conducted by engineers acting for Duluth men whose interest was enlisted by L. E. Stein, now of Hawthorne.

▶ Shipments of gold ore have continued in substantial volume from leases on the large Douglas property southwest of Mina and owned by Harry E. Springer, of that town.

▶ Equipment, including a diesel engine, has been delivered at the Windfall mine, formerly a notable producer of silver, gold, and lead, 4 miles south of Eureka and owned by W. F. Snyder & Sons, of Salt Lake City. The surface plant was burned in 1936 when the mine was being reopened after a long shutdown.

▶ Property of the Castle Peak Quicksilver Company, 6 miles north of Virginia City, in Storey County, has been optioned to William N. Albee, of Detroit, and will be sampled at once by Albee's associate and engineer, Royal D. Gardner. The Castle Peak mine, under management of H. E. Loufek, of Reno, has been one of the foremost producers of mercury in Nevada.

▶ Operating at near capacity, the lately completed bucket-line dredge of the Manhattan Gold Dredging Company is handling around 12,000 cu.yd. of gravel per day on the flat desert a mile from the outlet of Manhattan Gulch in Nye County. The dredge has reached bedrock at 94 ft. below surface, digging 70



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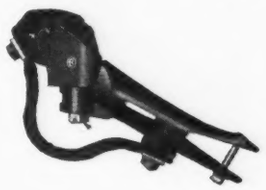

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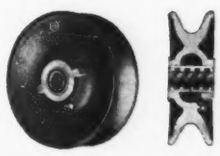

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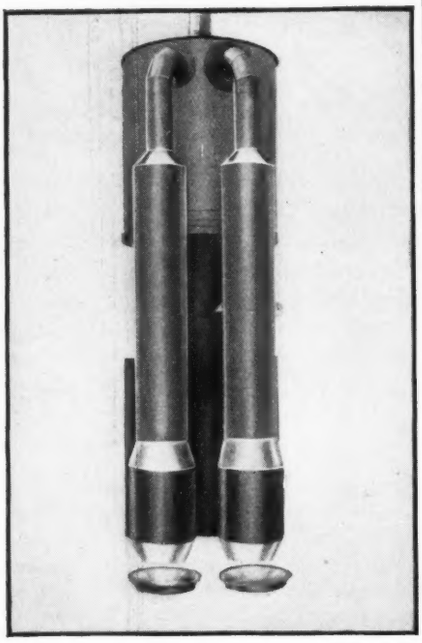

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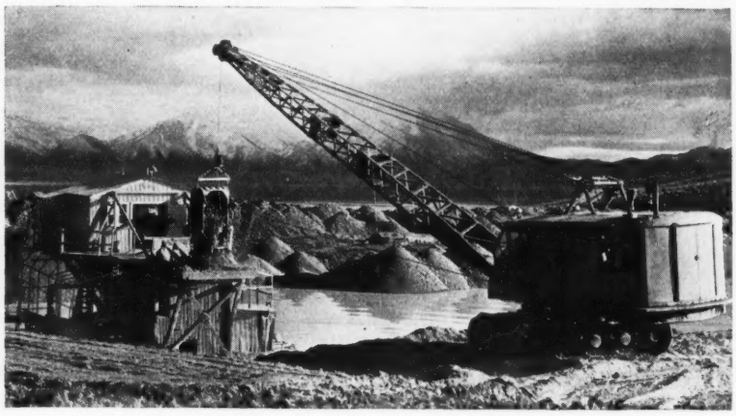
▶NEVADA

ft. and carrying a 24-ft. bank above water. A monitor washes down the bank ahead of the dredge. John L. James is general superintendent.

▶ The Scheelite property and 60-ton concentrating mill of the Nevada Tungsten Corporation, controlled by Reno men and situated in the Pine Nut range southeast of Gardnerville, in Douglas County, have been purchased for J. Alden Armstrong, of New York City, by Ott F. Heiser, manager for the Nevada Massachusetts Company, Inc.

▶ Production of the Mountain City Copper Company is averaging 2,000,000 lb. a month. Concentrate from the Elko County, Nev., property is now being hauled over the road to Elko, the last link of which was recently improved.



Mill Gulch Placer Mining Company, Camp Raleigh, via Beowawe, Nev.; reported a substantial increase in gold production in 1938. The Bodinson dredge and Link-Belt 2-cu.yd. shovel excavate and treat about 1,300 cu.yd. of gravel per day

COLORADO

Rehabilitation Planned At Mattie Mine

Property in Idaho Springs was recently acquired by Federated Metals, of Colorado—Crushing plant to be erected at Veta Mines—Sorting plant under construction at Alta Mines property

▶ The Mattie mine and mill at Idaho Springs will soon be operated by Federated Metals of Colorado, Inc. This property was closed down in 1933, when internal strife forced the company into receivership. Since then some of the blocked-out ore has been mined and some workings have caved. The vein, 4 to 7 ft. wide, contains gold, silver lead, zinc, and copper. The equipment includes a 50-ton mill that may be enlarged, hydro-electric power, compressors, an aerial tram and mine hoist.

▶ The Trail Run Mines, Inc., in the Idaho Springs district, plan to install a new compressor and hoist. Charles Gresser is president and C. R. Wilfley, general manager.

▶ Through the aid of modern equipment and advanced methods of recovery, the Veta Mines expect to treat successfully 400 tons of ore per 24 hours. The new tram line, from the mill to the Pennsylvania, or fifteenth level, together with the 400-ton plant, was recently completed. This spring a crushing plant will be built at the Pennsylvania. Robert H. Sayre, of Denver, is president of the company.

▶ A new washing and sorting plant is being installed at the Alta Mines, in the Telluride district. This mine and mill lie between Ophir and Telluride at an elevation of 12,000 ft. A crosscut is being driven towards the St. Louis vein on the property and about 1,200 ft. remain to be driven.

▶ Kissell & Company, Cripple Creek and Colorado Springs mine operators, have taken over the B&M mine, at Ward, and started a development program. The property has been producing for the past two years under lease held by Johnson and Larsen.

▶ On Jan. 26 the annual convention of the Colorado Mining Association and the Colorado Chapter of the American Mining Congress was officially called to order. Among the speakers were Earl Harding, of New York City, who discussed raw material prices and business recovery at the annual sow-belly dinner. Hans T. Lundberg, of Toronto, Canada, discussed recent developments in geophysical prospecting, and George T. Malone, of San Francisco, and former State Engineer from Nevada, discussed the need for Western industrial development. Other speakers were Dr. H. B. Miller, of Pittsburgh, Pa., who talked on occupational disease insurance; E. D. Gardner of Tucson, Ariz., United States Bureau of Mines; Ernest V. Gent, secretary, of the American Zinc Institute; Baldwin B. Bane, head of the registration division of the Securities and Exchange Commission; Dr.

Charles H. Behre, Jr., professor of economic geology at Northwestern University; Max W. Bowen, general manager of the Golden Cycle Mill at Colorado Springs. A. H. Zeilinger spoke on "I Believe in Safety."

▶ The number of producing lode mines, prospects and dumps worked in Colorado during 1938 was about the same as in 1937. About 74 ore reduction mills were operated during 1938, and about fifty ran for shorter periods during the year. The 24 mills operating continuously had capacities ranging from 10 to 1,600 tons per 24 hours. About seventeen mills handled custom ores, either exclusively or along with company ores.

▶ At present two problems are being studied in the Cripple Creek district to permit deeper operations. They are the unwatering to lower depths through a new deeper drainage tunnel and the possibility of a large central pumping plant below the present Roosevelt drainage tunnel, and pumping water up to it, which will permit operations below present levels. Good ore is known to exist at lower levels.

MICHIGAN

Mine Assessment Procedure Changed

Experts of the State Conservation Department will examine mining properties for tax purposes, thereby reverting to practice formerly employed.

▶ The Michigan State Tax Commission has announced that two experts of the State Conservation Department have started a survey of mining properties in the Upper Peninsula copper and iron districts. This marks a return to the assessment procedure used for years before the former Democratic chairman, John N. Fegan, altered assessments on the basis of a WPA survey of the mines. F. G. Pardee, mining engineer, and G. E. Eddy, mining geologist, of the Conservation Department will examine the copper properties this month and the iron mines next month. The surveys of the Conservation Department experts, upon which mine assessments were based for years, were subordinated during Fegan's term as chairman of the Tax commission to data obtained through a WPA survey and by Fegan himself. The WPA survey was ordered halted after the November election when former Republican Chairman Melville B. McPherson resumed control of the Tax Commission.

▶ The Federal Power Commission at Washington has announced postponement until Feb. 2 of a hearing scheduled at Washington Jan. 19 on an application of the Copper District Power Company for authority to build a conversion dam on the middle branch of the Ontonagon River in Ontonagon County, Mich. The postponement was asked by the Michigan Attorney General, who intervened on behalf of the State Conservation Department. The power company is a subsidiary of the Copper Range company.

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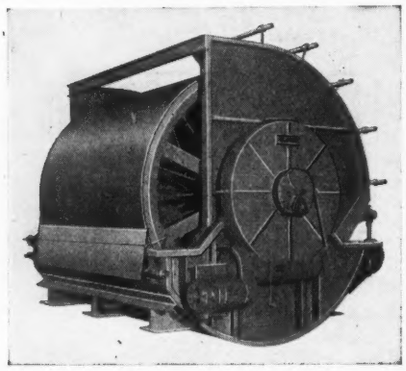

CONTINUOUS - VACUUM

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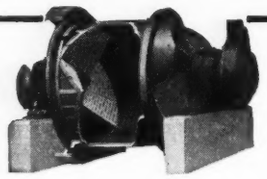

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IRON COUNTRY

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▶ Ore consumption by furnaces during December amounted to 3,040,700 tons, and the balance on hand on Jan. 1 at docks and furnaces amounted to 34,578,849 tons. From these figures it is estimated the balance on May 1 should be about 21,000,000 or 22,000,000 tons, as from all reports it is expected that consumption will run at least 3,000,000 tons per month and predictions are now that the Lake Superior district will enjoy at least a 40,000,000 ton shipment for the 1939 season.

▶ Many companies are doing some little clean-up or stripping work at their mines during the winter months, and all shops are open and putting equipment in first-class shape for the season ahead. The Pickands-Mather Company is maintaining stripping operations three shifts per day five days per week at the Scranton mine, at Hibbing, and the Oliver Iron Mining Company is operating fair-size crews at its various operations on the Mesabi range. Other independent companies are doing similar work.

▶ Labor conditions on the Mesabi Range of Minnesota remain steady. Wage rates have been standardized so that no changes have occurred in the earning rate of any of the workmen, although the number of working days has necessarily been shortened compared to the regular operating season. Most of the men are receiving about four days per week from the various operating companies, and in some cases shop men and "key" men are either on a salary basis or working five days per week. Virtually all of the mining companies have restored salaries that were cut during 1938.

TRI-STATE

Properties Near Waco Being Rehabilitated

K. C. B. Mining & Development Company has leased 500 acres—Hudson Lead & Zinc Company will operate mill on Goodeagle property—Plant for processing tripoli being erected

▶ The K.C.B. Mining & Development Company, Inc., has taken a lease on 500 acres in the vicinity of the old Anderson mines, about two miles southeast of Waco, Mo. A derrick has been erected over the old mill shaft and a 6-in. Pomona turbine pump to be powered with either a gasoline or diesel engine will be installed. Derricks are also being erected over two field shafts, 145 and 60 ft. deep. The latter shaft will be deepened to 145 ft., at which depth mining will be carried on at the three shafts. James Barr, of Joplin, Mo., Lloyd Cole and M. T. Kohl, of Webb City, are interested in the company.

▶ Hudson Lead & Zinc Company has taken over the operation of the mill on the Goodeagle lease, one mile west of Cardin, Okla., formerly operated by the Miami Big Five Mining Company, according to George B. Cox, of Joplin, one of the partners. Ore for the operation of the mill will be furnished under contract by Joe Gerhart and George Duncan, of Baxter Springs, Kan., who are in charge of mine operations at three shafts on the lease. Approximately 250 tons of ore will be mined daily.

▶ The Barnsdall Tripoli Corporation, of Seneca, Mo., began the construction of a new $100,000, all-steel mill early in January to replace the plant destroyed by fire in December, according to Everett Dobbs, vice-president and general manager for the corporation. The new mill will have a capacity of 200 tons daily, and will include all new equipment of latest design for the crushing and processing of the tripoli. Approximately 10 men will be employed in the new mill instead of the 18 men previously employed. The company operates two tripoli quarries near Seneca, where about 25 men are employed. Some tripoli is also purchased from independently operated quarries.

CANADA

Noranda to Senneterre Railway Service Begins

Event is celebrated in growing gold-mining district of Quebec—Development at MacLeod-Cockshutt confirms drilling results—Bear River area, on Van Couver Island, attracts interest

▶ On Dec. 3 and again on Jan. 21 the mining camps of northwestern Quebec were stirred by record-breaking celebrations. The first one marked the opening of the 100-mile branch line of Canadian National Railways from Noranda to Senneterre, costing $6,000,000. The second was the official opening of the East Malartic mill. Within the area served by the new line there are fourteen gold mines that produced more than $40,000,000 in metals last year and give employment to a population of 70,000. In the vicinity of Rouyn and Noranda capital invested amounts to $300,000,000. It is believed nowhere else in the world has mining development advanced so rapidly in the last decade.

▶ East Malartic Mines turned over its mill in December, and in the first month worked up to a daily average of 800 tons of ore averaging about $5.85 a ton. Developed to production by J. P. Norrie, the mine is now under the supervision of Futterer and Reid, consulting engineers. General Engineering Company built the mill, the largest put up last year in northern Quebec.

▶ In reviewing O'Brien Gold Mines for

the fiscal year ended Oct. 1, the general manager, J. G. Dickenson, states that operating profit before write-offs, tonnage put through the mill, and gold bullion all reached the highest figures in the company's history. Ore reserves to the 13th level are 127,874 tons valued at $16.80 per ton, which is more than ten thousand tons above estimates a year ago, with a slight reduction in grade.

▶ Three other mills in Cadillac Township are in regular production, including the Thompson, adjoining O'Brien on the west. Recent discoveries of high-grade on the 150 and 450 levels give encouragement for improving feed to the 200-ton mill. The new 10-ton roaster for treating the refractory arsenic concentrates was put into operation in January. H. C. Young is manager and Bob Bryden consulting engineer.

Ontario

▶ The Sachigo River mine, in the northwest corner of Ontario 120 miles east of God's Lake, has established a record for the first half-year production as the richest in the country. Average recovery for that period from the 30-ton mill was $60.12 a ton, almost a third greater than recovery reported for the Privateer, in British Columbia. Ore above the first level, still untouched, grades $82.95 a ton, and the west drift heading on the first level assays 8 oz.

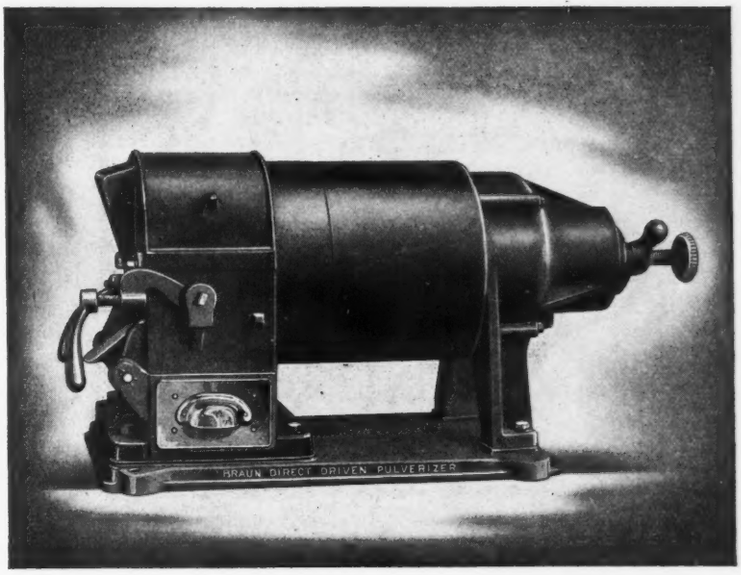
▶ Madsen Red Lake Gold Mines increased recovery in December 55 per cent above the original ore estimate made by Eldon Brown, consulting engineer. Mill rate is being advanced to 375 tons as soon as a new compressor has been set up, to be followed by a development campaign on the third level.

▶ Underground development on the north ore zone at MacLeod-Cockshutt Gold Mines confirms the discovery made a year ago by diamond drills. Drifting results on three levels down to 500 ft. in the iron formation lying 1,000 ft. north of the original shaft indicate 1,858 tons of ore per vertical foot with a cut grade of $9.66 a ton. Preliminary information on the 800-ft. level has led to an estimate of 807 tons per vertical foot averaging $8.96 uncut. Drifting on this level has 400 ft. yet to go eastward to reach the boundary of Hard Rock Gold Mines, where a drill hole showed three intersections of good grade and width below 600 ft. Considerable ground remains to be explored on the south zone, which is to be opened up for its full length down to the third level.

Manitoba

▶ A major expansion program announced for Hudson Bay Mining & Smelting serves to emphasize the remarkable record made by this Flin Flon mine since operations were started in 1930. Before next June all the ore sent to the smelter will come from underground, in contrast to only about 30 per cent a few years ago. Since 1937 the gold content of the ore has been sufficient to pay all operating costs, with other charges amounting to 2c. per pound on copper and zinc, after credit for silver. The original estimate of 18,000,000 tons to 900-ft. depth has now advanced to

BRAUN DIRECT-DRIVEN PULVERIZER



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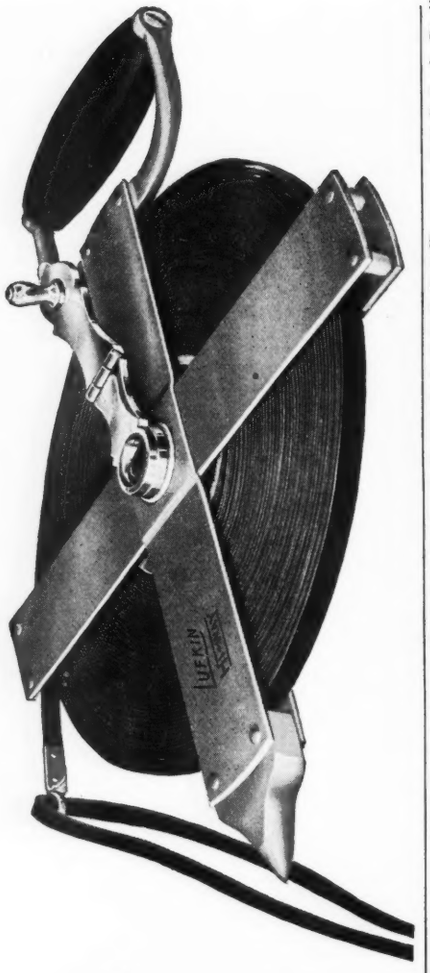

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▶CANADA

about 38,000,000 to 2,210 ft., and there are good prospects for further stepping up the figure when these horizons are more fully explored.

British Columbia

▶ Employment by the Consolidated Mining & Smelting Company of Canada at its Tadanac and Warfield metal, chemical, and fertilizer plants reached a new peak in 1938, when the payroll averaged 4,290 men. The previous record of 4,020 men was established in 1937. These figures do not include the company's employees at the Sullivan mine and elsewhere throughout Canada. S. G. Blaylock, vice-president and managing director, in announcing the figures given, said that the maintenance of operations at full capacity last year regardless of market conditions resulted in the accumulation of tremendous stocks of metals and fertilizers and a serious decline in profits.

▶ Privateer Mine, Ltd., operating a rich gold property at Zeballos, has declared its first dividend, 5c. a share, or a total of $120,704, 22 months after underground work was commenced and three months after the start of production.

▶ Mount Zeballos Gold Mines, Ltd., has been incorporated to continue the development of the Farris group at Zeballos, where a promising vein has been opened in two tunnels having a total length of 1,600 ft. Conwest Exploration Company, of Toronto, and the Farris Syndicate, of Vancouver, are the joint owners. John Goss is in charge of operations.

▶ Attention has been directed to the mineralogical possibilities of the Bear River area, 25 miles east of Tofino and 60 miles south of Zeballos on the west coast of Vancouver Island, by favorable showings disclosed on the Musketeer and Shamrock groups. Pioneer Gold Mines, of Vancouver, and Anglo-Huronian, of Toronto, have jointly optioned the ground, and a small crew of men is conducting exploration work under Frank Joubin, geologist.

▶ Favorable development of both quartz veins and limestone replacement deposits at the Island Mountain mine, Wells, have augmented reserves considerably during the past year. The shaft has been deepened from the 3,500 to the 3,000 level and lateral work will be started there shortly. T. H. Munn is superintendent.

▶ A length of 100 ft. of ore has been opened to date at the Canty mine, Hedley, in drifting at the 400 level. This is quite encouraging, as the ground was broken at the 200 level and values were not continuous.

▶ A comprehensive development program conducted during the past year at the Nicola mine by the new owners, Consolidated Nicola Goldfields, Ltd., is stated to have established the regularity of the vein system and proved additional bodies of ore. The 100-ton mill is being rehabilitated and enlarged, and it is planned to resume production when three years' supply of ore has been developed. John F. Coats is the engineer in charge of operations.

▶ At the Reeves-Macdonald mine, where a large tonnage of zinc-lead ore has been indicated, 2,000 ft. of tunneling and 1,300 ft. of diamond drilling was done last year, and work will be continued in the spring.

▶ Ymir Yankee Girl Gold Mines, Ltd., has discontinued exploration at its original property, near Ymir, and is searching for another mine elsewhere in British Columbia.

▶ Milling was discontinued permanently at the Bayonne mine on Jan. 2, as the ore deposits have been exhausted. H. T. Wilson, of Vancouver, secretary, reports the company is searching for another property.

MEXICO

Threats of Labor Strikes Continue

Several companies confronted with new demands imposed by workers in labor contracts—Miners' cooperative at Guanajuato Reduction & Mining property plan larger operations

▶ Uneasiness because of the labor trend and continuance of the general economic depression that has become more acute since expropriation of the oil companies obtained in the Mexican mining industry with the advent of midwinter. Work was generally slowed down, and the spread of properties going into the hands of their employees to run on a cooperative basis was watched with apprehension. Fears were entertained that yet another American-backed enterprise, Cia. Minera de El Cubo, S.A., Mineral del Cubo, Guanajuato, L. M. Lane, manager, would become a cooperative because of restlessness on the part of its workers.

▶ Success was claimed for several mining cooperatives. But the industry saw some hope in prospects of settlement of the oil controversy, though all attempts in that regard have failed since expropriation last March 18. A general strike in the mining industry is not seen at this time; but several companies are having labor troubles. Small-scale miners, who are arranging their first national convention for this winter at a site that has not yet been selected, are urging the Federal Government to authorize free minting of silver. They say that that will benefit mining and general economy.

▶ The 1,400 employees of Guanajuato Reduction & Mining, Guanajuato City, who were recently given charge of the property to run on a cooperative basis because the company found further work unprofitable, have become ambitious. They are arranging to expand their activities this winter to include exploiting the Valencia mine, an old and rich silver producer; the La Luz property, and to revive work at the San Pedro mines and mill. This extra operations are intended to employ at least 1,500 more men.

▶ Action has been taken by the Federal Labor Department to eliminate the thrift

custom of some old and new mining companies of employing prospectors and other free-lance miners to do most of their mining. Unionized miners complained about this practice, which they asserted is illicit, as such employees are not protected by the Federal labor law.

▶ Cananea Consolidated Copper, Cananea, Sonora, ended a work disturbance by increasing the payment rate for piece workers. The company accused these workers of cutting production by as much as 60 per cent as a demonstration of their dissatisfaction with the old pay.

▶ Demand for a new labor contract has been made upon Cia. Minera de Santo Domingo, S.A., Nacozari, Sonora, by its workers.

▶ Suits to upset the order of the Federal labor authorities that they must allow their low-salaried employees a weekly paid day off have been filed in a Mexico City district court by Mexican Zinc and Cia. Carbonifera, S.A., Nueva Rosita, Coahuila. They aver that the order is not in accord with work contracts they recently made with the national miners' union.

▶ American Smelting & Refining is faced with a demand for 750,000 pesos (about $150,000) made by the national miners' union for employees of the company's Aquiles Serdan unit, Chihuahua, who say this compensation is due them because the company violated collective labor contracts.

▶ A strike threat unless their new collective work contract is accepted has been made against American Smelting & Refining by employees of its Angangueo unit, Michoacan, Frederick Brown, general manager.

▶ Cia. Industrial El Potosi, Chihuahua City, E. P. Ryan, general manager, milling organization of El Potosi Mining, is improving its 2,500-ton flotation plant that handles silver-zinc-lead ore, with the installation of equipment including a Dorr FX Multizone classifier.

AFRICA

Tanganyika Attracts Many Prospectors

Germans, Greeks, Italians, French, and Belgians investigated possibilities of Territory during year—Geita Gold Mining Company completes first mill unit

▶ Mining and prospecting activities in Tanganyika Territory are set forth in a bulletin just isused by the Imperial Institute, South Kensington. It states that 884 prospecting licenses were issued during the past year, and that 39 companies are operating there. Besides gold with silver content worth £526,338, appreciable amounts of salt, tin, mica, diamonds, tungsten, lead, phosphates, and red ocher were produced. Though British predominate among those holding prospecting rights and conducting developments, many Germans, Greeks, Italians, French, and Belgians are also active there. The Tanganyika Government has invited companies to prospect for coal, which is known to occur.

▶ Geita Gold Mining Company has completed the first unit of its mill in the new district south of Lake Victoria and started crushing at full capacity. This is the enterprise started and owned almost wholly by Kentan Gold Areas, Ltd., which in turn is controlled by Tanganyika Concessions and Zambesia Exploring Company. Of all the new properties developed in Tanganyika Territory and Kenya Colony, the Geita alone appears to have the extensive ore deposits and reserves necessary to make an important producer. New discoveries continue to be made on its property and surrounding ground, and from around the outcrop of one prospect 2,000 oz. of gold has been recovered.

▶ Though a definite statement is still lacking that Ashanti Goldfields will largely increase its productive capacity, the company is about to raise £750,000 of cash by selling 250,000 shares of 4s. each to shareholders at a price of £3 each. At the same time it will distribute 1,000,000 shares—1 for each 5 held—of full-paid shares as a bonus. Ashanti might almost be said to be facing an embarrassment of profits. Its issued capital is £1,000,000, has a market value of over £20,000,000, and net earnings for the present year are expected to be about £1,250,000. The small mill makes it impracticable to treat any of its large tonnage of medium-grade ore, and recent developments having added heavily to its very high-grade resources, it is milling ore averaging about 1¼ oz. per ton. Evidently, it is intended to bring reduction capacity up to the size of the mine. Future plans will be announced at a special meeting to be held Jan. 31. J. H. Batty is chairman.

▶ Kimingini Gold Mining Company, which erected a 100-ton mill in the Kakamega district of Kenya Colony, has gone into voluntary liquidation, its ore reserves being exhausted. Drilling failed to find any continuation of the ores at depth. The company has some £30,000 of cash and equipment for sale, which should increase its distributable funds considerably.

▶ Development results in the Vlakfontein Gold Mining Company's property, which lies immediately east of Sub Nigel, are being watched with great interest because of their bearing on what may be expected still farther east. Sub Nigel workings have indicated that its very rich though narrow shoots would extend into this area. Formed in November, 1934, Vlakfontein decided to avoid the delay which would result from drilling and started sinking a vertical shaft which was expected to cut the reef at a depth of some 7,000 ft. Sub-verticals from the bottom of this shaft has now cut the reef at a depth of 6,568 ft. and revealed an average of 12.3 dwt. per ton over a width of only 1.3 in. More recently a second sub-

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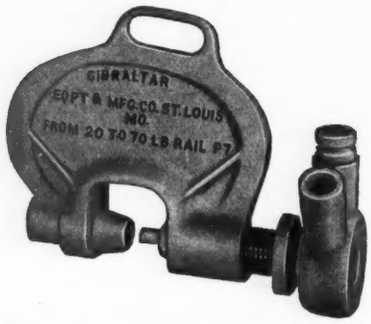

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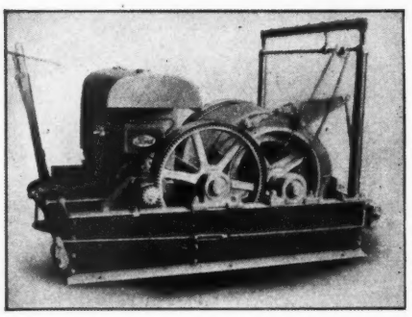

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▶AFRICA

vertical has reached the reef some 262 ft. distant from the first discovery and finds there an average of 1.8 dwt. over a width of 10.5 in. In the meantime a haulage level has been extended into the ground from Sub Nigel workings for a distance of 495 ft. and of 445 ft. sampled, 195 ft. gave an average of 75.9 dwt. per ton over a reef width of 6.9 in. The haulage results encourage the management to believe the richness of Sub Nigel exists at still greater depth. What is called the Far East Rand is still much farther east, and despite the common assumption, Vlakfontein developments, good or bad, seem to have little bearing on what may be found there.

AUSTRALIA

Prospects at Wiluna Improved by Drilling

New ore find in southern end of property as determined by drill is 18½ ft. wide—Low metal prices threaten to close Central mine at Broken Hill—Mount Isa will increase production capacity

Western Australia

▶Improved prospects for Wiluna were forecast by the chairman (J. A. Agnes) at the annual meeting recently. He said that a borehole had recently cut a lode 18½ ft. wide in the southern end of the property. This was an entirely new occurrence which strengthened belief in the possibilities of that section. On the Bulletin leases, a new shoot 350 ft. long and assaying 6.2 dwt. over a width of 9½ ft. had been exposed at the lowest (1,200 ft.) level, and in the Happy Jack section diamond drilling indicated the existence of an important body 600 ft. long and averaging 7.6 dwt. over a width of 33 ft. A new roasting method, evolved at the Lake View & Star mine, was under test; if successful, it was estimated that profits would be increased by 3/– to 3/6 per ton.

▶Consolidated Gold Areas, N.L., which was unsuccessful on the Hampton field, has optioned the Blue Spec mine, near Nullagine, a total area of 140 acres.

▶Grade of ore treated by Yellowdine Gold Development, Ltd., Yellowdine, has dropped in recent months, and yields now average about 9 dwt. per ton. A working profit of nearly £10,000 per month is being made, however.

▶Youanmi Gold Mines, Ltd., Youanmi, reports that the sulphide section of the mill was brought into operation in May last, making total mill capacity 10,000 tons monthly.

▶Operating profit of Gold Mines of Kalgoorlie, Ltd., was estimated at £41,440 sterling for the six months to Sept. 30. In the Iron Duke section of the property a geological study of the lower Hinchcliffe area has disclosed several promising objectives, and diamond drilling has already encountered several makes of ore, the best of which averages 10 dwt. per ton over a width of 8 ft. 2 in.

▶Lack of working capital has forced North Kalgurli United, one of the de Bernales group, to close down, active operations ceasing on Dec. 15 last.

▶Leases at Evanston Yilgarn district, which were under option to Western Mining Corporation, Ltd., but were later abandoned by that company, are now reported to have been taken under option by a Melbourne company.

Victoria

▶Prospects for Cocks Eldorado Gold Dredging, N.L., Eldorado, appear good. In spite of dry weather conditions for the greater part of the year to Sept. 30, the company during that period increased its net profit by over £30,000 to £71,711 Australia, the higher grade of ground treated, averaging 15.26d. per cu.yd., being responsible. Material treated totaled 1,846,660 cu.yd., which yielded 10,560 oz. smelted gold and 181 tons of 73.9 per cent tin concentrate. Known gravel reserves are 15,500,000 cu.yd., averaging 9.26d., plus 4,500,000 cu.yd. of deep ground, worth 10.85d. per cubic yard, below the 70 ft. level (which is estimated to net £100,000 after providing for a stacker and necessary mechanical equipment), together with some 15,000,000 cu.yd. of prospective wash, indicated by drilling, but not yet close-bored, which may prove payable on more detailed examination. The whole shows a prospect of some seventeen years' life in all for the property.

▶Mining operations in the Bendigo district during 1938 resulted in a yield of over 45,000 oz., practically equivalent to the previous year's figure. Of the total, 28,816 oz. came from company operations, the average grade of ore treated being 4.95 dwt. per ton. The remainder was contributed by prospectors and other small parties. The most interesting development at the close of the year was the discovery at the Deborah mine, in the crosscut at the 1,160-ft. level, of a new saddle formation which is quite distinct from the main reef of the mine. The appearance of the stone is favorable, and the new discovery may develop into a payable reef.

New South Wales

▶Prospects of New Occidental Gold Mines, N.L., Cobar, are discussed in a recent report by C. E. Blackett, general manager, on operations for the period Dec. 1, 1937, to Sept. 11, 1938. On the figures disclosed, Mr. Blackett estimates that working profit for the coming year, based on a treatment rate of 3,000 tons weekly, should be £157,000 Australia. Ore reserves at the New Occidental mine total 624,000 tons of proved and probable ore, about six years' mill feed. At New Cobar, proved ore reserves, after allowing for tonnage extracted, show an increase of 23,400 tons to 138,900 tons. The intended adoption of shrinkage stoping at both mines will, it is estimated, result in a saving of 5/- per ton.

▶The possibility that the Central mine, at Broken Hill, may close down was

mentioned at the annual meeting recently of the Sulphide Corporation, which owns the mine. Unless costs can be reduced, or metal prices improve, it is likely that this step will be taken, in which case, as ore reserves are nearing exhaustion, it is probable the mine will not reopen.

Queensland

▶ Increase of production at Mount Isa by about 10 per cent will be effected by additional plant now being erected, the chairman, Julius Kruttschnitt, announced recently. This step is being taken to combat rising costs due to higher wages, dearer supplies and deeper mining.

▶ Operation of the new smelting and converting plant is expected early in February at Mount Morgan, Ltd.

Tasmania

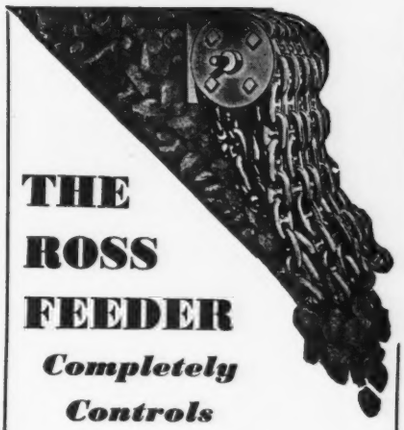
▶ As the grade of ore reserves continues to decline, the Mount Lyell Mining & Railway Company, Ltd., intends to increase still further the tonnage being treated, which is the largest at any Australian mine. The total put through last year was 1,032,128 tons, and it is intended to step this up gradually to about 1,300,000 tons per annum. A new coarse crusher of 5,000 tons' daily capacity is being put in to increase the capacity of this section. The machine, of Australian manufacture, should be in operation in about four months.

FINLAND

Large Nickel Mine Plans Production in 1940

Finnish subsidiary of Mond Nickel Company will build 1,000 ton nickel smelter, and plans calls for large expenditures to bring property into production

▶ Petsamo Nikkeli Oy, Finnish subsidiary of the Mond Nickel Company, through which the International Nickel Company of Canada operates its properties in Finland, is preparing the Kaulatunturi mine for production next year. A company town of several hundred inhabitants has been established at Kolosjoki, and work has been started on the hydro plant and transmission lines. A 1,000-ton smelter is to be built that will have an estimated monthly output of 1,000,000 lb. of nickel and half that quantity of copper. International Nickel has spent $1,000,000 to date on diamond drilling and surface exploration and has announced plans calling for an expenditure of six times that amount to bring the mine into production. The extensive ore deposits are reported to average 1.61 per cent nickel and 1.32 per cent copper. The operation will be under the management of C. I. Simcox, formerly assistant to the general superintendent of International Nickel. Norman Kearns and W. B. Ibbotson will be engineers on construction. All three left Sudbury early in January for Finland.



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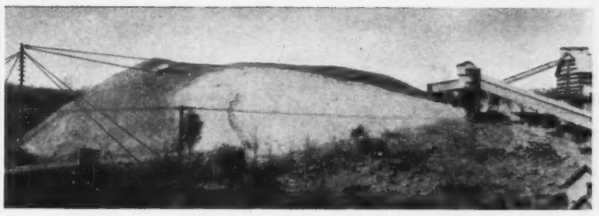

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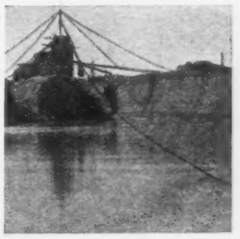

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ANNOUNCEMENT!

- For the past six months we have been compiling data for a new and revised edition of our Metallurgical Bulletin to take the place of the 1929 and 1932 editions.

- The data have been compiled by collaboration amongst all three of our companies and will be of particular interest to managers, metallurgists, mill superintendents, operators and senior students in ore dressing.

- The bulletin will contain approximately 125 pages and we hope will be ready for distribution the latter part of February.

- Following our usual practice, we shall be glad to mail a copy to those who are interested upon receipt of prompt request addressed to our Salt Lake City, Toronto or London offices.

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